

REVISION OF THE CALLIONYMID FISHES REFERABLE TO
THE GENUS *CALLIONYMUS* FROM AUSTRALIAN WATERS

CLIFFORD RAY JOHNSON*

Department of Zoology, University of Queensland

ABSTRACT

The genus *Callionymus* Linnaeus from Australian waters is revised. *C. ocelligena* McCulloch is considered a synonym of *C. calcaratus* Macleay, *C. limiceps sublaevis* McCulloch has been raised to specific level, *C. macdonaldi* Ogilby has been redescribed, *C. kaianus moretonensis* has been described as a new subspecies, and *C. punctatus* Langsdorff has been added to the known callionymids of Australia.

The systematic treatment of callionymids in general has been poor due to the lack of appreciation of their sexual dimorphism and the scarcity of specimens in museum collections. A world wide revision is needed and regional revisions such as this may provide a basis for more extensive treatment.

Lack of knowledge concerning sexual dimorphism has resulted in several species being erected erroneously in Australian waters. Also many attempts, particularly by earlier Australian workers, to subdivide the genus *Callionymus* has further complicated the situation, with almost every Australian species being typed as a new genus at one time or another. These attempts have met with little success and are not generally accepted. As more taxonomic work is done on this group, some Australian species may be synonymized with other Indo-Pacific species. The possibility of additional species being added to the known Australian callionymid fauna is ever present as exploratory sampling is lacking along much of the coastline and few localities have been sampled deeper than 180 m.

McCulloch (1929) listed 14 species within the genus *Callionymus* from Australia. One of these species has since been placed in the genus *Synchiropus* (Schultz *et al.*, 1960). Mees (1963) synonymised two species and added several others to the known callionymid fauna of Western Australia.

* Present address: Department of Zoology, University of New England.

In this work, it has been possible to synonymise two species, raise one subspecies to the specific level with further information on biology and distribution, redescribe one species, describe one new subspecies, and add two species to the callionymid fauna of Australia. Corrections have been made of erroneous reports of species upon re-examination of misidentified museum material.

Material examined in this study was collected from Moreton Bay with an 8 fathom Siebenhauser otter trawl (1½" mesh, measured stretched) operated aboard the R/V *Wanderer* II, and at various locations offshore along the Queensland coast with standard commercial prawning gear operated aboard several vessels, mostly the L. F. B. *Bossanova* and the L. F. B. *Jodi*. Some material was also beach seined. Fathoms have been used rather than meters when reporting depth distribution to be consistent with earlier records. Additional material was examined from the collections of various museums. List of abbreviations of museums and collections are as follows:

AM	Australian Museum, Sydney
BM	British Museum (Natural History), London
CAS	California Academy of Sciences, San Francisco
QM	Queensland Museum, Brisbane
SAM	South Australian Museum, Adelaide
USNM	U.S. National Museum of the Smithsonian Institution, Washington
P	Western Australian Museum, Perth
KU	Kyoto University, Maizuru, Japan
F	Dept. Agriculture, Stock and Fisheries, Research and Survey Station, Kanudi, Papua
FMNH	Field Museum of Natural History, Chicago
SU	Stanford University, Stanford

All lengths are standard length (SL) and all measurements are in mm. All measurements are direct measurements. Most of the measurements used are self explanatory. The following definitions have been used for some that are not self evident or characteristic of callionymids: head length is measured from the tip of the snout to the gill opening; head width is measured at the base of the preopercular spines; snout length is measured from the tip of the snout to nostrils; postorbital length of head is measured from the rear edge of eye to posterior edge of gill openings; length of caudal peduncle is measured from the base of the last anal ray to the midbase of the caudal fin; body depth is greatest body depth. Head width should be considered a crude measurement which is dependent upon the condition of the branchial chamber at the time of preservation.

KEY TO SPECIES AND SUBSPECIES OF CALLIONYMUS FOUND IN AUSTRALIAN WATERS

1. Preopercular spine stout, recurved, bent or angular with recurved tip and spines along inner margin 2

	Preopercular spine slender (possibly stout), spear-like, straight or very slightly curved with serrations or teeth along inner margin; basal antrorse spine present.....	10
2 (1).	Antrorse spine present on base of preopercular spine.....	4
	Basal antrorse spine absent.....	3
3 (2).	DIV, $7\frac{1}{2}$; anal $6\frac{1}{2}$; preopercular spine curved upwards, with 2 hooks <i>C. papilio</i>	
	DIV, $8\frac{1}{2}$; anal $7\frac{1}{2}$; preopercular spine curved upwards, with 2 hooks <i>C. calauropomus</i>	
	DIV, $8\frac{1}{2}$ or $9\frac{1}{2}$; anal $7\frac{1}{2}$; preopercular spine curved upwards, with 3 hooks <i>C. phasis</i>	
4 (2).	DIV, $8\frac{1}{2}$; anal $7\frac{1}{2}$; preopercular spine with 3 hooks..... <i>C. calliste</i>	
	DIV, $9\frac{1}{2}$ (rarely $8\frac{1}{2}$ or $10\frac{1}{2}$); anal $9\frac{1}{2}$ (rarely $7\frac{1}{2}$, $8\frac{1}{2}$ or $10\frac{1}{2}$); preopercular spine with 2–5 hooks	5
5 (4).	Preopercular spine with 2 hooks	6
	Preopercular spine with 3–5 hooks.....	8
6 (5).	Preopercular spine slightly curved upwards with a barbed tip; first dorsal with a large black blotch between 2nd and 4th spines, first dorsal spine filamentous..... <i>C. kaianus moretonensis</i> sub sp. nov.	
	Preopercular spine curved inwards.....	7
7 (6).	Upper surface of cranium and supraorbital region rugose..... <i>C. limiceps</i>	
	Upper surface of cranium and supraorbital region smooth and covered by integument	<i>C. sublaevis</i>
8 (5).	Raised crests and circular pits along each side of the occiput; first dorsal in males grey, in females black with anterior spines white to grey.....	
 <i>C. macdonaldi</i>	
	No raised crests or circular pits along each side of the occiput; first dorsal with dark blotch.....	9
9 (8).	Preopercular spine broad; blotch on dorsal large, light in males and dark on a white background in females..... <i>C. calcaratus</i>	
	Preopercular spine long, approximately the length of eye; dorsal blotch of concentric shape in males, in females the first dorsal is dark grey to dusky <i>C. punctatus</i>	

- 10 (1). DIV, $8\frac{1}{2}$; anal $7\frac{1}{2}$; preopercular spine more or less straight with 5-12 small serrations 11
 DIV, $9\frac{1}{2}$; anal $9\frac{1}{2}$ or $8\frac{1}{2}$; preopercular spine with 6-16 coarse spines or barb-like serrations. 12
- 11 (10). Snout slightly shorter than eye; only 1st pectoral ray simple *C. rameus*
 Snout larger than eye; 1st and 2nd pectoral rays simple *C. goodladi*
- 12 (10). First dorsal on line with gill openings; 1st and 2nd pectoral rays always simple *C. grossi*
 First dorsal not on line with gill openings; sometimes only 1st pectoral ray simple 13
- 13 (12). Caudal short, does not equal body less head *C. belcheri*
 Caudal elongate, equals body less head 14
- 14 (13). Two bony bucklers, one on each side of occiput, with smooth ridges or tubercles radiating from their centres; median area behind eyes covered with smooth integument *C. japonicus japonicus*
 Two bony bucklers, one on each side of occiput, with rugose ridges radiating from their centres; median area behind eyes covered in bony rugosities *C. japonicus scaber*

Callionymus japonicus japonicus Houttuyn

Callionymus japonicus Houttuyn, 1782, p. 311.

Callionymus reevesi Richardson, 1844, p. 60.

Callionymus longicaudatus Temminck and Schlegel, 1845, p. 151.

Callionymus Belcheri Bleeker, 1879, p. 85 [not *C. belcheri* Richardson, 1844]

Calliurichthys japonicus: Jordan and Fowler, 1903, pp. 942-3. McCulloch, 1929, p. 338.

Callionymus numeri Tanaka, 1917, p. 12.

Callionymus, *Calliurichthys japonicus* [sic]: McCulloch, 1926, pp. 196-7.

[?] *Callionymus affinis* Ogilby, 1910b, p. 134 [not *C. affinis* Regan, 1908]

Callionymus affinis: McCulloch, 1929, p. 339.

MATERIAL EXAMINED: 2 specimens, 106 and 175 mm SL (Research and Survey Kanudi, unregistered and F01705 respectively), from waters N. of Cape York Peninsula off Yule I. and Bramble Cay, Gulf of Papua.

DESCRIPTION: Dorsal IV, $9\frac{1}{2}$; anal $8\frac{1}{2}$; pectoral i16ii or i16iii; ventral I,5; caudal i16ii or i16iii; body compressed in front and elongate; snout pointed; preopercular spine strong and straight with 7-16 barb-like serrations along inner margin; caudal elongate,

equals body less head; 1st or 2nd or both dorsal spines filamentous in males; occipital region with a pair of elevated crests (bony bucklers) separated by smooth integument of head.

Head length 4.19 to 4.58; head width 5.60 to 6.25; length of pectoral fin 5.22 to 6.04; body depth 11.00 to 11.14; all in standard length. Eye 3.06 to 3.74; snout 2.87 to 2.99; pectoral fin length 1.24 to 1.32; all in head length. Eye 1.02 to 1.30 in snout.

COLOUR IN ALCOHOL: As described by Jordan and Fowler (1903).

SEXUAL DIMORPHISM: Marked sexual dimorphism exists in colouration and fin shape. In the male the anterior dorsal spines are produced into long filaments and the median caudal rays are produced. Snout length is also greater in the male. All the dorsal spines are short in the female. The median caudal rays are produced in the female but are usually shorter than the body while those of the male are characteristically longer. The snout is blunt in female specimens. Colour differences between sexes are quite evident with a deep brown to black blotch on the chest and the branchiostegals greyish brown to black in the male. The female undersurface is pure white and the chest blotch is absent.

REMARKS: Since no specimen of *C. affinis* was available for examination, I can not be sure that it would be placed under *C. j. japonicus*. McCulloch (1926) synonymized *C. affinis* with *C. j. japonicus* from an examination of the only existing specimen (now appears to have been lost) and since he described *C. j. scaber* it seems unlikely that it would be placed under this subspecies. Other subspecies may be erected when an examination is completed on a world wide basis.

DISTRIBUTION: Previously from south of New Guinea, station 188 (Günther, 1880) and off Cape Moreton, SE. Queensland (Ogilby, 1910b; McCulloch, 1929).

***Callionymus japonicus scaber* McCulloch**

Callionymus japonicus scaber McCulloch, 1926, p. 197.

Callionymus longicaudatus Waite, 1898, p. 60. McCulloch, 1923, p. 8.

MATERIAL EXAMINED: 85 specimens, 91–193 mm SL, coastal south Queensland (20 miles SE. of Double Island Point, 32–3 fm; E. of Noosa, 41–46.5 fm; and off Caloundra, 41–46.5 fm). One specimen, off Caloundra, QM 18209.

DESCRIPTION: Dorsal IV, $9\frac{1}{2}$; anal $8\frac{1}{2}$; pectoral i16ii, ii16i, iii16i, i17i or ii17i; ventral I, 5; caudal i7ii; ridges or bucklers (elevated crests) are very rough and the area behind the eyes is covered with similar bony rugosities; preopercular spine with 9–12 serrations along inner margin; otherwise same as *C. j. japonicus*.

Head length 4.24 to 4.81; length of pectoral fin 5.00 to 5.77; head width 4.36 to 5.58; depth of body 8.47 to 13.30; all in standard length. Eye length 3.00 to 3.60; snout 2.73 to 3.46; pectoral fin 1.18 to 1.20; all in head length. Eye 1.00 to 1.11 in snout.

COLOUR IN ALCOHOL: These specimens agree with the colour description of Jordan and Fowler (1903) except that the following slight differences were noted. Remarks in parentheses refer to Jordan and Fowler's description. Light grey above (deep rich brown) with numerous rounded spots of grey and brown (pale brown) margined with dark brown; ventral surface white to yellowish (pure white), males have a dark brown to black (rich brown) blotch on the chest, branchiostegals greyish in males and white in females.

SEXUAL DIMORPHISM: As for *C. j. japonicus*.

REMARKS: Slight differences were noted in the proportions of the head length and of the eye in snout from the material reported upon by Jordan and Fowler (1903) but these were within the ranges given in de Beaufort and Chapman (1951) for *C. j. japonicus*. The differences in head length could be due to the method of taking measurements as the criteria for measurements are not mentioned by any of the above workers. Munro, 1967, and de Beaufort and Chapman, 1951, both report 7 to 8 serrations along the inner margin of the preopercular spine in *C. j. japonicus*. My material (*C. j. scaber*) ranged from 9 to 12 (usually 10) serrations.

DISTRIBUTION: Previously from Lord Howe I., off New South Wales (type locality) (McCulloch, 1926), and now SE. Queensland.

***Callionymus kaianus moretonensis* subsp. nov.**

(Figs. 1–5)

HOLOTYPE: Adult female, 158.3 mm SL, 7 miles E. of Cape Moreton, southeast Queensland (approximately 27°02'S lat. 153°36'E long.) 68–72 fm, collected by L.F.B. *Bossanova* at night on 4 August 1969, AM I15608.00.

PARATYPES: Five, 95.2–149.0 mm SL, AM I15608-002–6; four, 130.9–164.9 mm SL, CAS 24764–67; all collected with the holotype. Two, 30 miles E. of Mooloolaba, 60–70 fm, 12–14 August 1967, R. Elks, QM I9156–7. One, southern Queensland, Department of Fisheries, QM I3428.

In addition, 894 specimens (74–162 mm SL) used in biological studies were recorded from southern Queensland off shore (7 miles E. of Cape Moreton 65–80 fm; 18 miles E. of Caloundra, 56–60 fm; ENE. of Noosa, 54–8 fm; 62–8 fm; E. of Mooloolaba, 59–67 fm). A few of these specimens will be deposited in the Queensland Museum and the United States National Museum.

DESCRIPTION: Spinous dorsal fin IV; second dorsal elements $9\frac{1}{2}$ (last ray branched at base); anal fin elements $9\frac{1}{2}$ (last ray branched at base); pectoral rays i17ii (19 specimens), i18ii (20 specimens); ventral rays I,5; caudal rays i7ii.

Measurements (mm) of holotype: Head length 42.4, greatest body depth 20.8, least depth of caudal peduncle 6.9, snout 9.3, bony interorbital 1.0, eye 13.1, postorbital length

TABLE 1

MEASUREMENTS IN PERCENT OF STANDARD LENGTH OR HEAD LENGTH (*) OF THE HOLOTYPE AND NINE PARATYPES OF *Callionymus kaianus moretonensis*

Sex	♀	♂	♂	♂	♀	♂	♂	♂	♀	♀
Catalogue no.	AM 115608 -001 holo- type	AM 115608 -002	♂ AM 115608 -003	♂ AM 115608 -004	♀ AM 115608 -005	♂ AM 115608 -006	♂ CAS 24764	♂ CAS 24765	♀ CAS 24766	♀ CAS 24767
Standard length(mm)	158.3	124.6	149.0	140.5	95.2	128.6	130.9	134.0	141.7	164.9
Head length	26.7	29.6	26.5	27.9	31.6	27.6	28.9	28.9	28.1	27.6
Greatest body depth	13.1	12.2	9.5	11.3	12.8	11.5	10.5	10.2	12.0	13.2
Least depth of caudal peduncle	4.3	3.0	3.6	3.8	3.5	2.8	4.1	4.0	3.2	3.9
Snout*	21.9	17.3	17.2	17.8	17.2	16.0	18.2	15.2	15.7	18.4
Bony interorbital*	2.3	2.1	3.7	2.0	1.6	2.2	2.1	1.5	2.0	3.5
Eye*	30.8	30.3	35.4	35.8	35.2	34.2	32.1	33.5	32.3	29.1
Postorbital length of head	10.9	11.8	10.8	11.5	13.9	10.3	11.2	10.5	11.2	12.6
Length of caudal peduncle	16.8	21.5	18.2	18.6	17.8	18.4	19.4	20.9	18.4	18.2
Snout tip to origin of first dorsal	26.8	26.9	25.9	27.3	28.8	26.3	26.7	26.1	26.9	25.6
Snout tip to anal origin	42.5	43.5	45.8	45.7	47.4	45.9	46.0	45.4	48.2	44.2
Length of first dorsal spine	25.9	22.9	24.0	20.7	31.5	22.6	19.9	21.1	21.0	22.4
Longest soft dorsal ray	17.9	20.7	18.1	18.6	21.1	18.5	19.0	17.8	19.8	20.4
Longest pectoral ray	17.6	19.5	17.4	17.5	21.1	18.8	18.2	18.2	20.3	20.0
Longest pelvic ray	23.6	23.6	21.2	20.2	24.2	22.7	23.5	24.0	23.4	23.2
Longest caudal fin ray	41.6	54.7	43.2	46.1	49.6	48.6	50.1	48.8	50.3	43.3
Tip of snout to rear edge of maxillary*	28.8	22.7	25.0	26.2	21.9	23.5	25.0	20.7	21.0	24.5
Length of preopercular spine	6.5	7.2	7.5	7.5	8.2	8.3	8.6	6.9	7.6	6.6

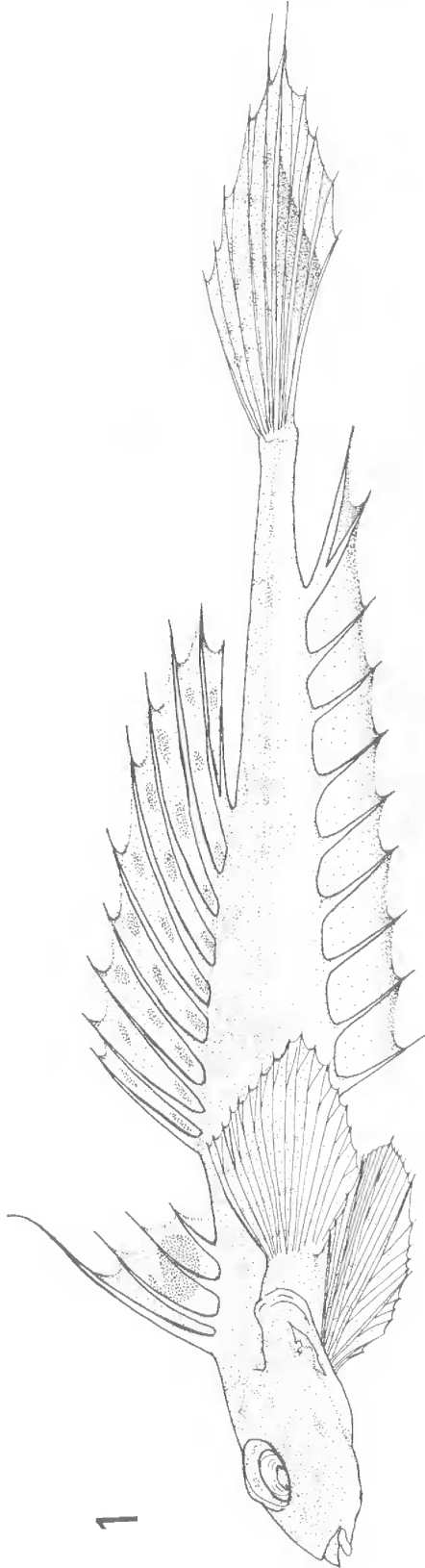
of head 17.3, length of caudal peduncle 26.6, snout tip to origin of first dorsal 42.5, snout tip to anal origin 67.3, length of first dorsal spine 41.1, longest soft dorsal ray 28.4, longest pectoral ray 27.9, longest pelvic ray 37.5, longest caudal fin ray 66.0, tip of snout to rear edge of maxillary 11.4, length of preopercular spine 10.3. Additional measurements are given in table 1.

Body elongate, compressed in front with greatest depth near 2nd and 3rd spine of first dorsal; body broader than deep tapering posteriorly. Head compressed, greatest depth about one-half width at preopercular spine; snout rounded, compressed above, greatest depth about one-half width; eyes close together, directed upward, 29.1 to 35.8% of head length; mouth small, inferior, jaws unequal, maxillary reaching nostril; dentition villiform, in approximately 8 bands upper jaw and 6 bands lower; preoperculum with a strong spine with a slightly recurved barbed tip with 2 barbs near tip and a strong basal antrorse spine (fig. 2). Gill openings small, slit-like, on upper surface of body approximately midway between origin of first dorsal fin and preopercular spine base and as far apart as outer margins of eyes.

Spinous dorsal inserted approximately midway, but nearer posterior margin of eye than origin of soft dorsal, spines long, the first produced into a long filament, decreasing in length posteriad; origin of soft dorsal just anterior to a vertical line through anal papilla; anal originating under 3rd dorsal ray, lower than soft dorsal, the last ray branched and produced; pectorals between origin of 3rd spinous dorsal and 4th dorsal ray, broad, with median rays longest; pelvics large, broad and longer than pectorals, originating before the gill openings and extending to about mid pectoral length and joined to base of pectoral by a broad membrane; caudal long, graduated above and below the median rays which are produced; caudal peduncle long and compressed, depth less than the eye.

COLOUR IN ALCOHOL: Background colouration dorsal greyish; ventral yellowish white, head and body marbled dorsally with brown markings, sides of body with 2 to 3 irregular brown blotches; dark brown blotch at pectoral base; first dorsal dusky to greyish with a large black irregular ocellated spot between 2nd and 4th spine; second dorsal with numerous brown spots regularly dispersed between the rays (2 on each membrane between 1st and 3rd ray, 3 on rest of membrane except 1 or 2 between last branched ray). Anal blackish distally, clear basally; caudal with blackish streak along ventral rays otherwise irregularly marked with brown spots; pectorals clear; pelvics dusky to yellowish basally, upper rays with brown bands. Life colouration not known.

SEXUAL DIMORPHISM: Little sexual dimorphism exists in this subspecies. No colour differences could be detected between sexes. The median caudal rays are produced and are longer in males. The first dorsal spine is slightly longer in males being produced in both males and females (fig. 3). Considerable sexual dimorphism is present in the length of the anal papilla as would be expected (fig. 4). The lack of sexual dimorphism in the other fins is here demonstrated by the example of the last anal ray in fig. 5. Ochiai *et al.* (1955) reported

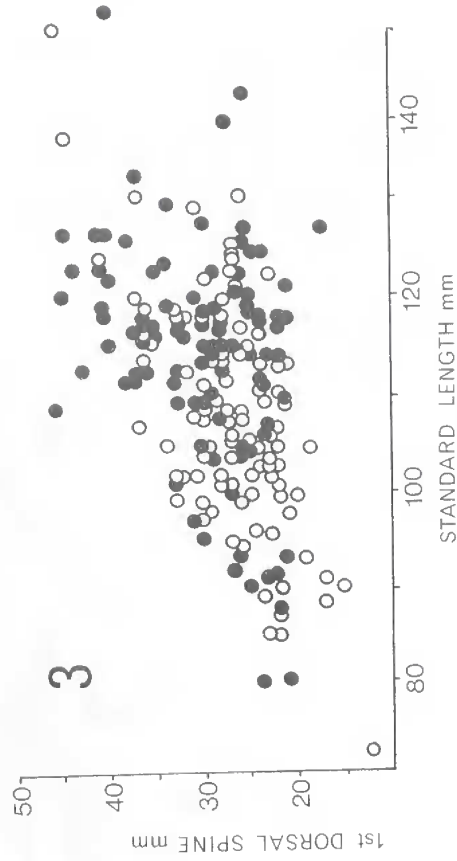


1



2 A

B



3

FIG. 1: *Callionymus kaitanus moretonensis* subsp. n. holotype, female 158.3 mm from off Cape Moreton, southeast Queensland.

FIG. 2: Preopercular spine of *C. k. moretonensis*. A, spine as it appears partly covered by integument; B, spine with integument removed.

FIG. 3: Sexual dimorphism of the first dorsal spine in *C. k. moretonensis*. Dark circles males (n=102), open circles females (n=104).

greater sexual dimorphism in the length of the first dorsal spine in *C. k. kaianus* from Japanese waters than was found in this subspecies.

REMARKS: Juveniles of 80 to 100 mm have only two spots on each membrane of the second dorsal and have the tip of the preopercular spine not barbed or only slightly barbed. At around 110 to 112 mm the barbed tip becomes more pronounced. Ochiai *et al.* (1955) reported the lack of barbed preopercular spine tips in young *C. k. kaianus*.

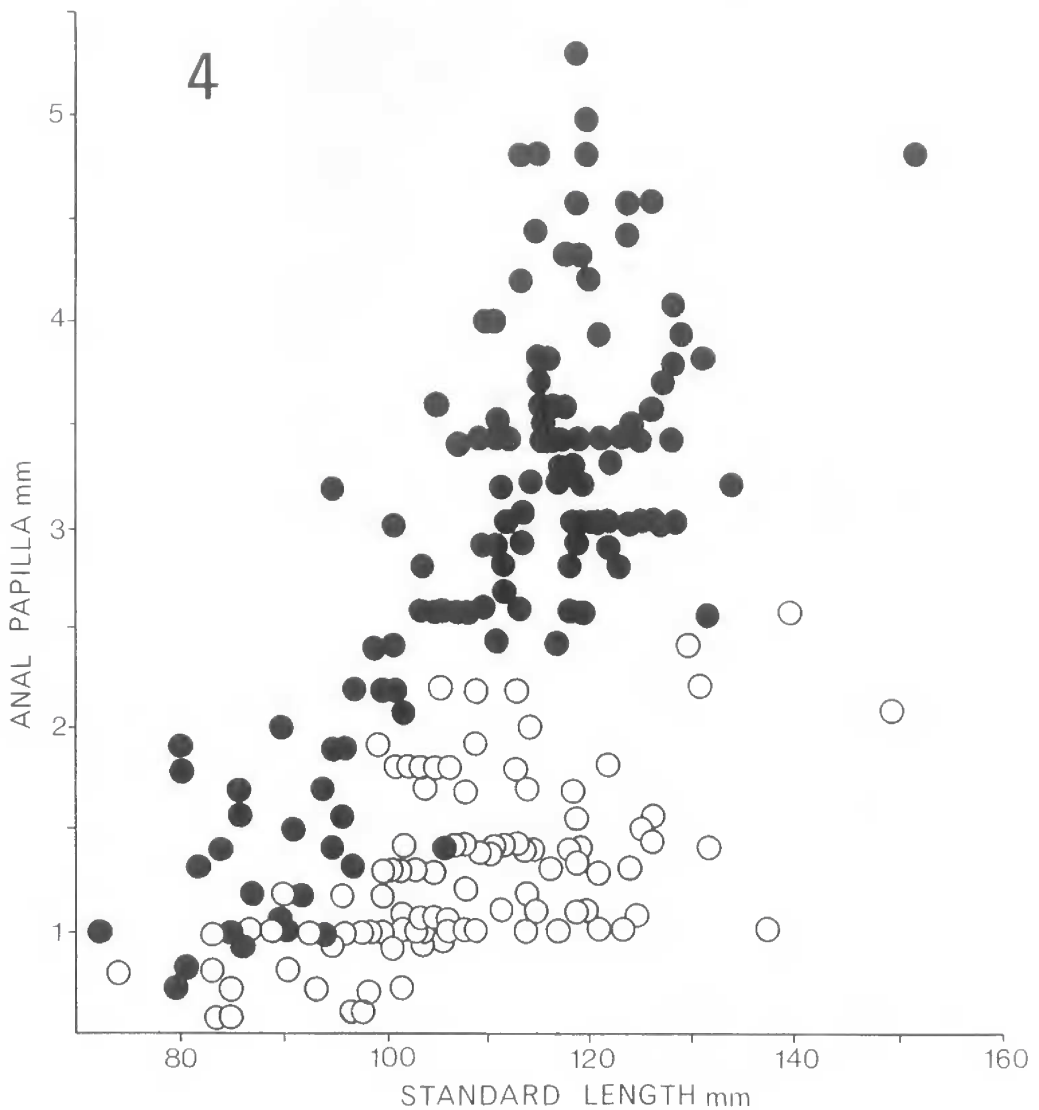


FIG. 4: Sexual dimorphism of the anal papilla in *C. k. moretonensis*. Dark circles males (n=130), open circles females (n=85).

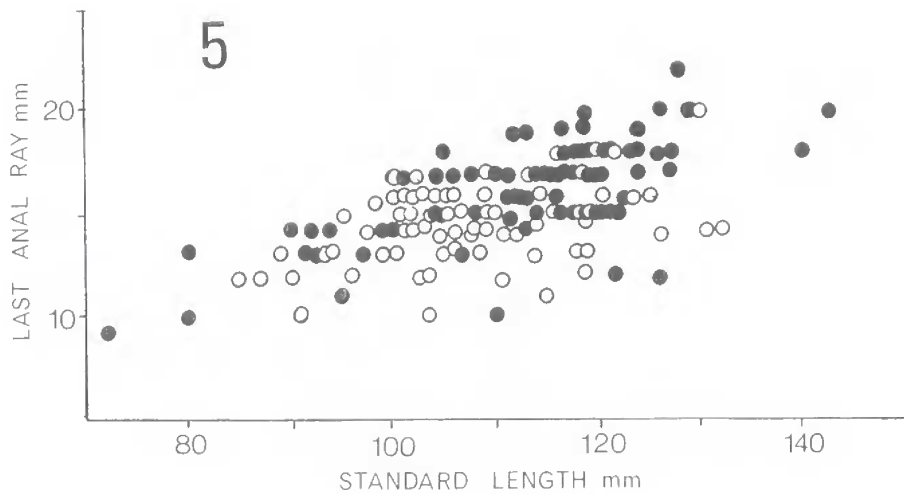


FIG. 5: Sexual dimorphism of the last anal ray in *C. k. moretonensis*. Dark circles males (n=81), open circles females (n=79).

Dr Alwyne Wheeler kindly examined the type specimen of *C. k. kaianus* (BM 1879.5.14.565) and sent me data and photographs for comparison with *C. k. moretonensis*, one specimen of *C. k. kaianus* was examined from Japan (KU 23274).

C. kaianus moretonensis can be readily distinguished from *C. k. kaianus* by the difference in body markings; regular pattern of spots on second dorsal versus irregular blotches in *C. k. kaianus*; the more anterior position of the lunate spot on spinous dorsal; the black band always present on the distal portion of the anal fin; and by a more slender preopercular spine.

ETYMOLOGY: The subspecific name *moretonensis* is taken from the type locality, Cape Moreton.

DISTRIBUTION: Known only from southern Queensland offshore.

***Callionymus punctatus* Langsdorff**

(Fig. 6)

Callionymus punctatus Richardson, 1846, p. 210.

Callionymus richardsoni Bleeker, 1854, p. 414.

Callionymus curvicornis Günther, 1861, p. 145.

Callionymus valenciennesi Schlegel, 1845, p. 153.

MATERIAL EXAMINED: 432 specimens, 57–105 mm SL, Moreton Bay (Shark Spit, Moreton I., 16 fm; 1 mile E. of Otter Rock, near Redcliffe, 3.5 fm; 4 miles E. of Redcliffe, 5 fm; 4.5 miles E. of Queens Beach, 5–6 fm; 6 miles E. of Scarborough, 8–9 fm; 1.5 to 2 miles E. of Bishop I., 2.5–3 fm; E. of St Helena I., 2.5–5 fm; E. of St Helena I. and Mud Islands, 4 fm; 7.5 miles W. of Tangalooma, Moreton I., 5 fm) and Gulf of Carpentaria 16°40'S, 139°42'E (one specimen, AM 115557–217). Museum material examined consisted of 34 specimens: USNM 177165, 71076(12); CAS 24868(2); KU 22093–94; SU 7758(3), 7948(6), 7759(3), 7854(3); FMNH 44956; AM 115557–217.

DESCRIPTION: Dorsal IV, $9\frac{1}{2}$ ($8\frac{1}{2}$ or $10\frac{1}{2}$ rarely); anal $8\frac{1}{2}$ ($7\frac{1}{2}$, $9\frac{1}{2}$, or $10\frac{1}{2}$ rarely); pectoral i13i2i (1 specimen), i14ii, i15i, or i15ii; ventral I,5; caudal i7ii, ii7ii or ii7iii; preopercular spine nearly as large as eye with 3 or 4 spines besides recurved tip and an antrorse spine at base; snout pointed, larger than eye; last soft dorsal and anal rays extend beyond caudal base; dorsal spines not filamentous; caudal long with median rays longest; first dorsal in male grey with irregular dusky blotches and a darker blotch (black in some specimens) between 3rd and 4th spine; first dorsal in female dark grey to dusky.

Head length 3.58 to 4.00; greatest body depth 9.00 to 10.66; postorbital length of head 10.13 to 11.40; length of caudal peduncle 5.79 to 6.50; snout tip to origin of first dorsal 2.90 to 3.14; snout tip to anal origin 1.91 to 2.00; longest soft dorsal ray 3.94 to 5.58; longest pectoral ray 3.94 to 4.34; longest pelvic ray 4.04 to 4.79; longest caudal fin ray 2.63 to 3.12; all in standard length. Least depth of caudal peduncle 4.80 to 5.48; snout 3.08 to 4.00; eye 3.04 to 3.43; length of first dorsal spine 1.53 to 2.44; tip of snout to rear edge of maxillary 3.16 to 3.87; length of preopercular spine 3.40 to 4.14; all in head length. Bony interorbital 8.75 to 12.43 in eye.

COLOUR IN ALCOHOL: As described by Ochiai *et al.* (1955). Background colouration of dorsal surface light brown, ventral surface yellowish to white; numerous light to dark brown streaks along the side of the body in males, may be faint or absent in females; first dorsal in males grey with irregular dusky to black blotches and a darker blotch (black in some specimens) between 3rd and 4th spines, fin edged in black; first dorsal in females dusky to black with anterior spines grey in Australian material, differing from Japanese specimens in lacking the ocellated black blotch on the membrane between the 3rd and 4th



FIG. 6: Some examples of variation in right and left preopercular spines of *Callionymus punctatus*.

spines; anal with a dark distal streak in males and white in females; caudal rays mottled with dark brown spots; ventral dusky distally and basally lighter (much lighter in females); upper pectoral rays spotted with brown, lower rays white.

SEXUAL DIMORPHISM: Besides the colour differences mentioned above, the length of the last dorsal rays, anal papilla, and caudal fin rays are greater in males. Spinous dorsal spines appear to be slightly larger in males. Some male specimens exhibit the female first dorsal colour pattern of the described material from Japan with the ocellated black blotch between the 3rd and 4th spines. This has also been discussed by Ochiai *et al.* (1955) and Jordan and Hubbs (1925).

REMARKS: This is the first report of this species from Australian waters and it appears to be very abundant wherever it occurs. Considerable variation occurs in the preopercular spine in this species (fig. 6).

DISTRIBUTION: Moreton Bay and Gulf of Carpentaria.

***Callionymus phasis* Günther**

Callionymus phasis Günther, 1880, p. 28. Macleay, 1884, p. 35. Waite, 1904, p. 51. McCulloch, 1922, p. 103; 1923, p. 9; 1926, p. 212; 1927, p. 77; 1929, p. 338; 1934, p. 77. Norman, 1937, p. 56. Ochiai *et al.*, 1955, p. 104–6. Mees, 1963, p. 98–9. Schultz *et al.* 1960, p. 403.

Callionymus apricus McCulloch, 1926, p. 209; 1929, p. 339. Waite, 1927, p. 231.

Yerutius apricus: Whitley, 1931, p. 115; 1948a, p. 27. Scott, 1962, p. 170.

MATERIAL EXAMINED: One specimen, 47 mm SL, collected 1921, AM IA.431.

DESCRIPTION: Dorsal IV, $8\frac{1}{2}$ or $9\frac{1}{2}$; anal $7\frac{1}{2}$; pectoral i17i; ventral I,5; caudal ii7ii; all dorsal rays divided; preopercular spine curved upwards at tip with 2 hooks along the inner margin and no antrorse spine at base; eyes large, high above profile of head; inter-orbital very narrow; origin of first dorsal only a little behind gill aperture.

Head length 3.14; pectoral fin length 4.27; head width 3.62; body depth 5.88; all in standard length. Eye 3.00; pectoral length 1.37; snout 5.00; all in head length. Eye 0.60 in snout.

COLOUR IN ALCOHOL: All colour markings faded, background colouration grey.

REMARKS: Ochiai *et al.* (1955) recorded *C. phasis* as new to Japanese waters, basing this record on a 44 mm SL specimen (KU24847) which on examination proves to be

C. calliste and not *C. phasis*. Because this specimen was called *C. phasis*, juveniles of *C. phasis* were thought to have simple dorsal rays, but since this misidentified specimen was the only evidence for this, *C. phasis* should be considered to have divided dorsal rays until proven otherwise.

DISTRIBUTION: Known from Twofold Bay, New South Wales; South of Drana Range, Gippsland, Victoria, 80 fm; Tasmania along eastern coast and the Great Australian Bight south from Eucla (Mees, 1963; Australian Museum record).

Callionymus grossi Ogilby

Callionymus grossi Ogilby, 1910a, p. 43. McCulloch, 1929, p. 338. Schultz, 1960, p. 403. Palmer, 1962, p. 548. Mees, 1963, p. 97. Marshall, 1965, p. 380. Johnson, 1970, p. 294.

Callionymus, *Calliurichthys*, *grossi* [sic]: McCulloch, 1923, p. 8; 1926, p. 195. McCulloch and Whitley, 1925, p. 173.

Callionymus Calliurichthys nasutus [sic] McCulloch, 1926, p. 197.

Callionymus nasutus: Marshall, 1951, p. 5; 1965, p. 380.

Callionymus (Calliurichthys) nasutus [sic]: Mees, 1959, p. 9.

Calliurichthys nasutus: Whitley, 1962, p. 226.

MATERIAL EXAMINED: 142 specimens, 45–146 mm SL, from the Gulf of Carpentaria 16°52'S, 139°39'E; Bowen; Cockle Bay, Magnetic I.; south coastal Queensland (6–10 miles N. of Noosa, 20 fm; 10 miles N. of Noosa, 21–2 fm; and E. of Caloundra, 15 fm); and Moreton Bay (1 mile W. of Shark Spit, Moreton I., 13–17 fm; off Sand Hills, Moreton I., 7.5–17 fm; 3 miles SW. of Tangalooma, Moreton I., 15 fm; off Lucinda Bay, Moreton I., 12–17.5 fm; E. of Mud I., 4–5 fm; 2 miles E. of Mud I., 6–8 fm; 2.5 miles E. of the southern tip of Mud I., 7–8 fm; 1 mile E. of SE. corner of St Helena I., 5 fm; ENE. of St Helena I., 5 fm; 4 miles E. of St Helena I., 5–6 fm). The following museum specimens were examined. Queensland Museum: I1579 (paratype, Bulwer, Moreton Bay), I7248 (Cockle Bay, Magnetic I.), I4239 (Bowen, N. Qld), I6855 (Mud I., Moreton Bay), Australian Museum: IB.326 (Shark's Bay), I15557-219.

DESCRIPTION: Dorsal IV, 9½; anal 8½; pectoral iii13i, ii13ii, ii13iii, ii14i or ii14ii; ventral I,5; caudal i7ii or ii7ii; preopercular spine straight with 9–16 serrations (antrorse teeth) along inner margin and an antrorse spine at base; origin of first dorsal in line with gill openings; first and second pectoral rays simple; first dorsal fins elongated in both sexes.

Head length 4.00 to 4.80; pectoral fin length 4.88 to 5.64; head width 5.00 to 5.58; body depth 9.39 to 11.18; all in standard length. Eye 3.12 to 3.88; pectoral length 1.08 to 1.41; snout 2.21 to 3.12; all in head length. Eye 1.00 to 1.65 in snout.

COLOUR IN ALCOHOL: Slight variations occur from the type material described by Ogilby (1910a). Ogilby (1910a) reported that a female (?) specimen was darker in colouration whereas the background colouration in males and females is similar in my material. Slight

differences do occur between the markings of males and females. In general the markings on female specimens are not as distinct as in males—the spotting on the soft dorsal and caudal is faint in females; females lack the blue spot on the membrane posterior to the 4th spine and some of the oblique crossbands are absent and others faint on the spinous dorsal.

SEXUAL DIMORPHISM: In addition to colour differences, sexual dimorphism occurs in snout length, anal papilla length and apparently in caudal fin length, all being longer in males. Both sexes have elongated spinous dorsal fins.

REMARKS: Mees (1963) reported one specimen having an anal count of $7\frac{1}{2}$ and that serrations on the preopercular spines of his material ranged from 10 to 18. Ogilby (1910a) originally reported 7 to 9 antrorse spines present. Examination of one paratype revealed 9 antrorse spines. A small female specimen 45 mm in standard length had only 6 and one female 71 mm had 7 serrations and like many callionymids the number of spines along the inner margin of the preopercular spine is probably a function of size and growth. One 22 mm specimen (AM IB.326) collected by Mr G. P. Whitley from Shark's Bay, Western Australia and identified by him as *C. calcaratus* upon examination by me appears to be *C. grossi*. The preopercular spine is straight and has only 3 antrorse teeth along the inner margin. It has an elongated spinous dorsal with IV, $9\frac{1}{2}$ and anal count of $8\frac{1}{2}$. This specimen and the 45 mm specimen mentioned above had none of the crossbanding on the first dorsal and lack spots on the dorsal and caudal fins, the membranes being mostly clear with a few darker mottlings. The body marking of the 45 mm specimen was characteristic of the adult colour pattern. Crossbanding on the spinous dorsal was more distinct in the 71 mm specimen; a few spots occurred on soft dorsal and caudal but fin membranes still had some clear areas.

DISTRIBUTION: From north and south coastal Queensland (Dunk I., 70 miles SE. of Cairns, 13 fm; off Townsville, 11 fm; near Lucinda, 9 fm (Johnson, 1970); Gulf of Carpentaria, $16^{\circ}52'S$, $139^{\circ}39'E$; Torres Straits; Lindeman I.; Point Denison (Aust. Mus. unpublished records, Paxton, pers. comm.); 13 miles SE. of Cape Capricorn (McCulloch, 1926, type locality of *C. nasutus*.)). In Western Australia from Shark Bay, Exmouth Gulf (Mees, 1963) and the Monte Bello Islands (Palmer, 1962).

Callionymus calauropomus Richardson

(Figs. 7–12)

Callionymus calauropomus Richardson, 1844–48, p. 10, pl. 7, figs. 4, 5. Günther, 1861, p. 147; 1880, p. 28. Castelnau, 1873, p. 49. Macleay, 1881a, p. 627; 1881b, p. 262. Tenison-Woods, 1883, p. 19. Lucas, 1890 (June), p. 29. McCoy, 1890, p. 333, pl. 192. Woodward, 1902, p. 271; 1903, p. 153. Waite, 1904, p. 51; 1921, p. 142; 1923, p. 165. Stead, 1906, p. 209; Ogilby, 1910a, p. 48. McCulloch and Waite, 1918, p. 48. Glauert, 1921, p. 46. McCulloch, 1922, p. 103; 1923, p. 12; 1926, p. 209; 1927, p. 77. McCulloch and Whitley, 1925, p. 173. Whitley, 1948a, p. 27. E. O. G. Scott, 1953, p. 157. Fowler, 1959, p. 493. T. D. Scott, 1962, p. 169. Mees, 1963, p. 95.

Callionymus aches De Vis, 1883, p. 620. Macleay, 1884, p. 35.

Callyonymus calauropomus: Castelnau, 1875, p. 21.

Foetorepus aches: Whitley, 1931, p. 323.

Synchiropus calauropomus: Schultz 1960, p. 405.

MATERIAL EXAMINED: 227 specimens, 78–133 mm SL from coastal southern Queensland (8 miles N. of Cape Moreton, 40 fm; E. of Caloundra, 41–42.5 fm). One specimen from Port Jackson, N.S.W. (QM 19927).

DESCRIPTION: Dorsal IV, $8\frac{1}{2}$; anal $7\frac{1}{2}$; pectoral i16i, i17i, i17ii or i18ii; ventral 1,5; caudal ii7iii or iii7iii; all dorsal rays divided (first sometimes simple); preopercular spine terminates in two hooks, bent upwards, no basal antrorse spine; only first ray of pectoral unbranched; origin of first dorsal nearly on line with gill openings.

Head 3.30 to 3.50; head width 3.67 to 5.35; length of pectoral fin 4.68 to 5.50; body depth 6.32 to 7.67; all in standard length. Eye 3.38 to 4.26; snout 3.48 to 5.68; pectoral fin 1.42 to 1.57; all in head length. Eye 0.60 to 1.19 in snout.

COLOUR IN ALCOHOL: Brown to grey above, white to yellow below; mottled with brown spots from eye along lateral line to caudal fin in male, lacking in female; a few spots radiate out on caudal rays; anal, pelvic, and dorsal black to dusky and pectoral pale in males; dorsal, pectoral, pelvics, caudal and anal dusky to white in females; in males the dorsal fin and pelvics mottled with dark spots with second dorsal streaked distally.

SEXUAL DIMORPHISM: Males are usually larger than females (fig. 7). The anal papilla is also longer in males. The greatest amount of sexual dimorphism appears in the median caudal filaments (fig. 8) in this species with lesser amounts occurring in the length of the last dorsal and anal rays (figs. 9, 10). Little sexual dimorphism appears in the rest of the dorsal spines or rays (figs. 11, 12). Colour differences were discussed above.

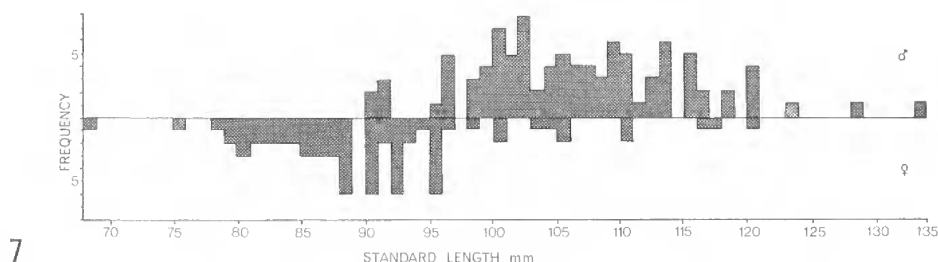


FIG. 7: Length-frequency of *Callionymus calauropomus* (males, n=97; females, n=67).

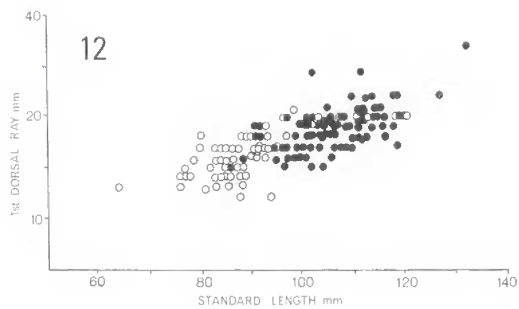
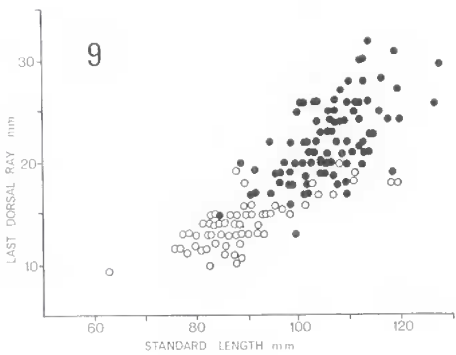
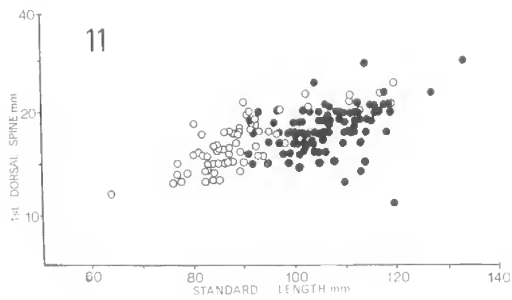
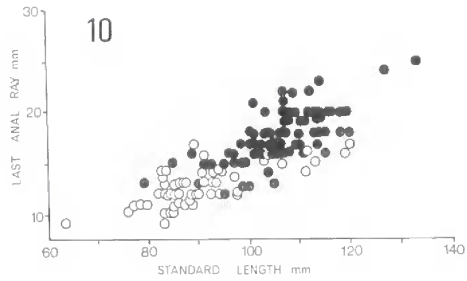
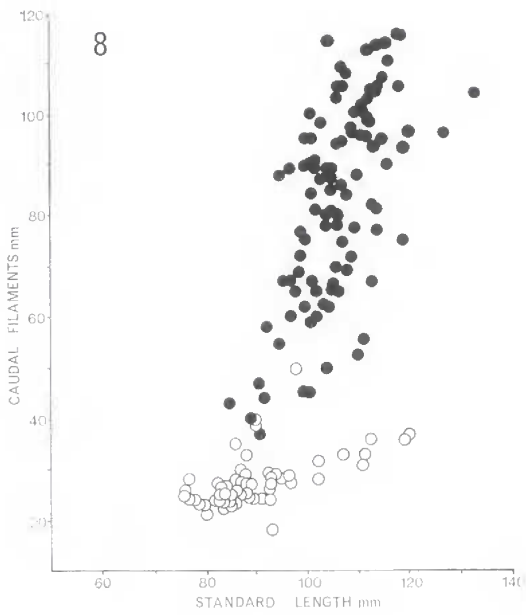


FIG. 8: Sexual dimorphism of the caudal filaments in *C. calauropomus*. Dark circles males (n=100), open circles females (n=69).

FIG. 9: Sexual dimorphism of the last dorsal ray in *C. calauropomus*. Dark circles males (n=100), open circles females (n=69).

FIG. 10: Sexual dimorphism of the last anal ray in *C. calauropomus*. Dark circles males (n=100), open circles females (n=69).

FIG. 11: Sexual dimorphism of the first dorsal spine in *C. calauropomus*. Dark circles males (n=100), open circles females (n=69).

FIG. 12: Sexual dimorphism of the first dorsal ray in *C. calauropomus*. Dark circles males (n=100), open circles females (n=69).

REMARKS: Many attempts have been made to subdivide the genus *Callionymus*, the most recent being that of Schultz *et al.* (1960) in which he placed this species under the genus *Synchiropus*. Mees (1963) attacked the validity of the genus *Synchiropus* avidly and I concur with his arguments. The genus *Synchiropus* is based on too few characters e.g. branched or simple dorsal rays (except in young) and the presence or absence of a basal antrorse spine on the preopercular spine. Schultz placed *C. rameus* in the genus *Callionymus* without comment even though it has branched dorsal rays and an antrorse spine (i.e. his generic limits break down with *C. rameus*). I have to agree with Mees (1963) that *S. calauropomus* should be restored to the genus *Callionymus*. Type material of the genus *Synchiropus* must be reexamined to determine the validity of this genus. I do not wish to comment on *Synchoripus microps* Günther or *S. splendidus* Herre, which can also be found in Australian waters, at this time.

DISTRIBUTION: From coastal southern Queensland (De Vis, 1883; Macleay, 1884; McCulloch and Whitley, 1925; McCulloch, 1929; Whitley, 1931; Mees, 1963). Known from New South Wales: Port Jackson (Macleay, 1881a; McCulloch, 1922, 1923, 1927; McCulloch, 1934); Eden (Mees, 1963); New South Wales (Tenison-Woods, 1883; Waite, 1904; McCulloch, 1923, 1929; T. D. Scott, 1962; Mees, 1963). From Victoria: Bass Straits, 38 fm (Günther, 1880); E. of Flinders I., Bass Strait (McCulloch, 1926); Port Phillip (Macleay, 1881a); Victoria coast (McCulloch, 1923, 1929; T. D. Scott, 1962; Mees, 1963). From South Australia: off Marsden Point, Kangaroo I. (McCulloch, 1926); South Australia coastline (McCulloch and Waite, 1918; Waite, 1921, 1923; McCulloch, 1923, 1929; T. D. Scott, 1962; Mees, 1963). From Western Australia: Michaelmas I., King George Sound; off Limestone I., King George Sound; off Bald I., between Albany and the Archipelago of the Recherche (Mees, 1963); Doubtful Island Bay, Southwestern Australia (McCulloch, 1926); coastal western Australia (Günther, 1861; Macleay, 1881a; Woodward in Fraser, 1903; Glauert, 1921; McCulloch, 1923, 1929; Whitley, 1948a; T. D. Scott, 1962). From Tasmania: Bridgport (Mees, 1963); Tamar River, at Launceston (E. O. G. Scott, 1953); coastal Tasmania (McCulloch, 1929; T. D. Scott, 1962; Mees, 1963). Also known from New Ireland, New Guinea Region (McCulloch, 1929).

Callionymus belcheri Richardson

(Figs. 13–17)

Callionymus belcheri Richardson, 1844, p. 62, pl. 37, figs. 1–2. [Not *C. belcheri* Bleeker, 1879].
McCulloch, 1926, p. 199; 1929, p. 339. Schultz, 1960, p. 403.

MATERIAL EXAMINED: 520 specimens, 34–107 mm SL, from North Queensland (Dunk I., 13 fm; off Townsville, 11 fm; off Cairns, 12 fm), coastal south Queensland (E. of Caloundra, 15 fm), and Moreton Bay (2 miles E. of Redcliffe, 2 fm; 6 miles E. of Scarborough, 7–8 fm; 1.5–2 miles E. of Bishop I., 2.5 fm; E. of Mud I., 3–7.5 fm; E. of St Helena I., 4–7 fm; 7.5 miles W. of Tangalooma, Moreton I., 5 fm; 3 miles SW. of Tangalooma, 15 fm; 4 miles N. of Shark Spit, Moreton I., 14–17 fm; 5 miles SW. of Shark Spit, 11–16 fm; W. of Shark Spit, 11–16 fm; W. of Sand Hills, Moreton I., 12–13.5 fm; Lucinda Bay, Moreton I., 6–18 fm; Brisbane River mouth, 2 fm). Three specimens, Kinikini B., New Guinea, FO969; 1 specimen, Sepik area, New Guinea, FO1386. Three specimens, Gulf of Carpentaria, 16°44'S, 139°33'E, AM 115557–220

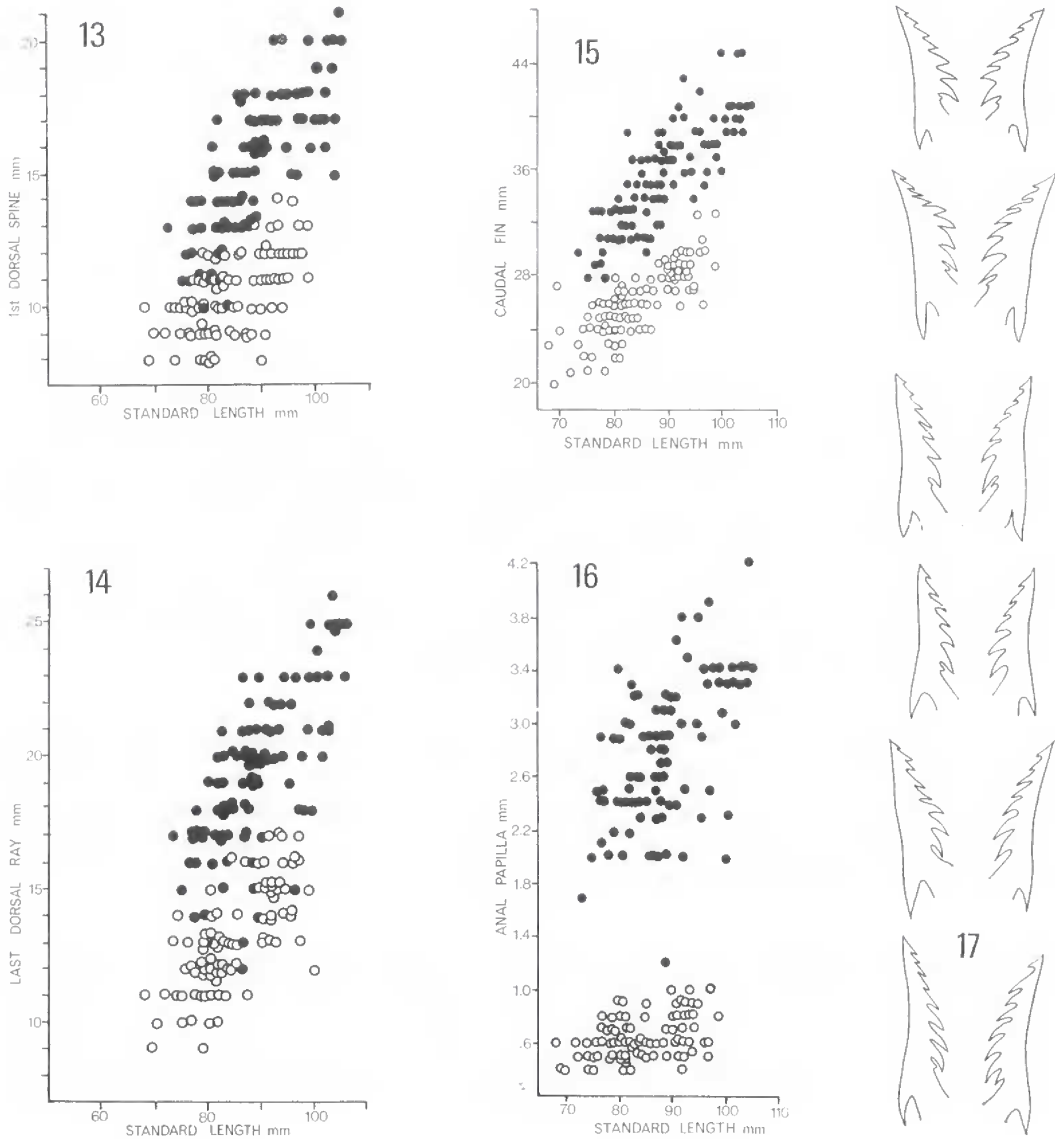


FIG. 13: Sexual dimorphism of the first dorsal spine in *C. belcheri*. Dark circles males (n=100), open circles females (n=100).

FIG. 14: Sexual dimorphism of the last dorsal ray in *C. belcheri*. Dark circles males (n=100), open circles females (n=100).

FIG. 15: Sexual dimorphism of the caudal fin in *C. belcheri*. Dark circles males (n=100), open circles females (n=100).

FIG. 16: Sexual dimorphism of the anal papilla in *C. belcheri*. Dark circles males (n=100), open circles females (n=100).

FIG. 17: Some examples of variation in right and left preopercular spines of *C. belcheri*.

DESCRIPTION: Dorsal IV, $9\frac{1}{2}$; anal $9\frac{1}{2}$; pectoral i14iii (mostly), i15ii, i15iii, i16ii or i16iii; ventral I,5; caudal i7ii; preopercular spine very large, with nearly straight tips directed slightly outwards, 6–7 large spines which increase in size anteriorly; head large, depressed and heart shaped; snout pointed; no membrane behind the 4th spine in spinous dorsal.

Head length 3.26 to 3.73; head width 3.04 to 3.28; length of pectoral fin 3.76 to 4.25; body depth 10.63 to 12.18; all in standard length. Eye 3.42 to 3.71; snout 2.71 to 3.25; pectoral fin length 1.13 to 1.20; all in head length. Eye 1.07 to 1.31 in snout.

COLOUR IN ALCOHOL: Yellowish brown above; chin and ventral yellowish white to white; two characteristic oval dark brown spots, one present on each side immediately below the lateral line, the first spot under tip of pectoral, the second above the 4th or 5th anal ray; first dorsal with a network of grey lines in males, dusky to black in females; 7–8 longitudinal grey lines on soft dorsal in males, these lines faint or non-existent in females; anal in male with a black submarginal stripe, anal white in female; oblique grey lines on membrane of upper caudal rays in males (faint in females) and irregular dots below, obscure brown bars on caudal rays in both sexes; pectorals and ventrals with grey to brownish dots. In prolonged preservation this species becomes very pale with few definite markings apparent; even the two characteristic spots on the sides disappear.

SEXUAL DIMORPHISM: A great deal of sexual dimorphism is apparent in this species. Both the spines and last ray of the dorsal fins are considerably larger in males (figs. 13, 14). The caudal fin is greatly lengthened in the male (fig. 15) as is the anal papilla (fig. 16). In contrast only slight sexual dimorphism occurs in the anal rays and this is most apparent in the last anal ray. Differences in colour between the sexes are discussed above.

REMARKS: McCulloch (1926) mentioned that *C. belcheri* was regarded as the young of *C. longicaudatus* Temminck and Schlegel (= *C. j. japonicus* Houttuyn) but he failed to mention that this was *C. belcheri* Bleeker 1879, a different species entirely to *C. belcheri* Richardson 1844. McCulloch did recognize that *C. belcheri* Richardson was not synonymous to *C. j. japonicus* or *C. longicaudatus*. Considerable variation is evident in the preopercular spines (fig. 17).

DISTRIBUTION: From north and south coastal Queensland, Gulf of Carpentaria, New Guinea and Pacific Ocean.

***Callionymus macdonaldi* Ogilby**

(Fig. 18)

Callionymus macdonaldi Ogilby, 1911, p. 56. McCulloch, 1923, p. 9; 1926, p. 205; 1929, p. 338. McCulloch and Whitley, 1925, p. 175. Schultz, 1960, p. 403. Marshall, 1965, p. 382.

MATERIAL EXAMINED: 8 specimens, 59–71 mm SL, from coastal Queensland (Townsville on beach; mouth of Moon Creek, on beach, Fraser I., 2–3 ft; Cribb I., Moreton Bay, seined 3 ft; E. of St Helena I. and Mud I., Moreton Bay, 4 ft). Twelve specimens from Queensland Museum: Townsville, on beach, I9928; Moreton Bay (holotype) I2473; Woody Pt, I8392–402. One specimen, USNM 177164.

DESCRIPTION: Dorsal IV, $8\frac{1}{2}$ (1 specimen), $9\frac{1}{2}$ (17 spec.), $10\frac{1}{2}$ (2 spec.); anal $8\frac{1}{2}$ (2 spec.), $9\frac{1}{2}$ (16 spec.), $10\frac{1}{2}$ (2 spec.); pectoral i2i13ii (1 spec.). i15ii, i16i or i17ii (usually); ventral I,5; caudal i6iii or i7ii (usually).

Measurements (mm) of holotype (96.8 mm in SL) are as follows: Head length 25.3, greatest body depth 11.4, least depth of caudal peduncle 4.5, snout 7.1, bony interorbital 1.0, eye 6.7, postorbital length of head 9.8, length of caudal peduncle 12.9, snout tip to origin of first dorsal 32.6, snout tip to anal origin 55.3, length of first dorsal spine 9.3, longest soft dorsal ray 14.7, longest pectoral ray 22.8, longest pelvic ray 24.4, longest caudal fin ray 26.7, tip of snout to rear edge of maxillary 8.2, length of preopercular spine 7.6. Additional measurements are given in table 2.

TABLE 2
MEASUREMENTS IN PERCENT OF STANDARD LENGTH (SL) OR HEAD LENGTH (*) OF THE
HOLOTYPE AND OTHER SPECIMENS OF *C. macdonaldi* OGILBY

Sex Cat. No.	♀ QM I2473 (holo- type)	♂ QM I8402	♀ QM I8400	♀ QM I8401	♀ QM I8399	♂ QM I8393	♂ ♀ ♀ personal collection not registered	♂	♀	♀
SL (mm)	96.8	62.7	66.6	59.4	63.9	54.6	71.7	71.1	69.5	
Head length	26.2	31.0	28.2	29.8	28.9	25.9	28.8	29.0	29.9	
Greatest body depth	11.8	12.0	11.9	12.9	13.7	10.8	13.4	13.8	13.4	
Least depth of caudal peduncle	4.7	6.2	5.1	5.4	5.6	5.0	5.2	5.8	5.8	
Snout*	28.1	31.4	25.7	28.8	28.0	24.1	24.3	23.3	26.0	
Bony interorbital*	3.9	3.9	4.3	4.5	3.3	4.3	4.4	4.9	3.8	
Eye*	26.4	24.2	25.2	26.6	22.0	31.1	27.2	29.1	25.0	
Postorbital length of head	10.1	13.1	11.6	12.5	12.4	11.0	11.6	11.8	12.2	
Length of caudal peduncle	13.4	14.4	14.6	12.5	14.1	12.8	14.5	14.2	13.8	
Snout tip to origin of first dorsal	33.6	36.5	35.2	39.8	38.6	34.4	35.4	37.8	37.2	
Snout tip to anal origin	57.2	58.4	51.1	57.4	57.8	53.4	55.8	57.8	56.6	
Length of first dorsal spine*	36.8	41.2	34.2	20.9	28.0	37.6	34.5	31.6	26.4	
Longest soft dorsal ray	15.2	18.5	14.9	13.3	15.9	18.3	16.5	14.2	14.7	
Longest pectoral ray	23.6	24.6	26.0	26.1	24.5	24.2	24.1	26.6	25.6	
Longest pelvic ray	25.2	26.2	25.4	24.4	20.7	25.3	24.3	23.9	23.5	
Longest caudal fin ray	27.6	25.6	25.8	24.4	26.7	22.9	27.5	26.1	27.3	
Tip of snout to rear edge of maxillary*	32.4	27.8	28.9	22.6	27.5	25.5	26.7	23.3	27.9	
Length of preopercular spine*	30.1	28.9	28.9	31.6	28.6	36.9	30.1	31.5	28.4	

Body depressed, greatest depth near origin of first dorsal; broader than deep, tapering posteriorly. Head large, depressed, greatest depth slightly less than width at base of preopercular spine; eyes close together, directed upward, interorbital space narrow, 5.9 to 7.4 in eye. Snout rounded, mouth small, jaws unequal, maxillary reaching back to below nostril; dentition villiform, in wide bands with approximately 8 to 12 rows of teeth in both jaws. Head rugose dorsally, bony ridges radiating from raised crests; shallow pits, mostly circular, profuse along bony crests the longest of which are on each side of the occiput. Gill openings on upper surface, midway between origin of spinous dorsal and posterior edge of orbits; space between gill openings less than space between outer margin of orbits. Preopercular spine with recurved tip slightly curved upward distally, with 5 large teeth (2nd and 3rd largest) along the inner margin ending in a recurved tip and with a basal antrorse spine.

Width of caudal peduncle greater than its depth at midlength; lateral line curved downward from head over pectoral fin, raised slightly at end of pectoral and extending posteriad slightly above midline of body to caudal base. Anal papilla present and shows sexual dimorphism. Ogilby (1911) and McCulloch (1926) both stated that the anal papilla was absent in this species; one is present, although small, on the holotype.

Spinous dorsal inserted approximately midway between 2nd dorsal insertion and posterior margin of orbit, short, not reaching second dorsal when depressed, 3rd spine slightly longer than rest. Last ray of second dorsal produced reaching hypural joint; all rays of dorsal simple except last which is branched at base. Anal lower than soft dorsal, all rays simple except last which is branched at base; last anal ray produced, reaching hypural; anal origin on vertical line between 3rd and 4th soft dorsal rays. First pectoral ray simple; upper margin of pectoral incised, median rays longest reaching to about the 4th soft dorsal ray. Ventral rays coarsely branched with 5th longest, reaching vent; broad membrane connects 5th ventral ray to base of pectoral; caudal rounded in both sexes.

COLOUR IN ALCOHOL: Background colouration highly variable, specimens collected from beach sands almost colourless to light grey to greyish white; from muddy environments darker in colour, grey to light brown; dorsal surface closely covered with white, irregularly



FIG. 18: Some examples of variation in right and left preopercular spines of *C. macdonaldi*.

shaped spots surrounded by an intricate pattern of fine brown lines; a few larger light to dark brown spots present; ventral surface white to yellowish; first dorsal of male grey, dark distally, white basally, in female black with anterior spines white to grey; second dorsal white to grey interspersed with dark spots, dusky posteriad; anal in males with rays white and membrane dusky, in females entire anal white; ventral fins irregularly spotted with a few faint to distinct brown bands present depending upon habitat occupied by specimen (e.g. sand, faint; mud, distinct bands); caudal white to grey with 4–6 irregularly dusky vertical bars.

SEXUAL DIMORPHISM: In addition to colour differences, the only marked sexual dimorphism is that of the anal papilla length. Anal papilla length measured in males 41 to 71 mm ranged from 0.76 to 2.32 mm (mean 1.36 mm) ($n = 9$) while in females from 38 to 96 mm this ranged from 0.24 to 0.84 mm (mean 0.50) ($n = 9$). Slight sexual dimorphism may occur in the length of the first dorsal spine and that of the longest soft dorsal, but not enough specimens have been available for examination to accurately determine this.

REMARKS: This species has been redescribed here to correct omissions and incorrect information given in the original description.

McCulloch (1926) stated that this species was closest to *C. calcaratus*. In my estimation *C. macdonaldi* is closest to *C. marleyi* Regan from which it differs in caudal ray counts and colouration (but colouration can be highly variable in both of these species). Specimens of *C. marleyi* examined by Smith (1963) appeared to show less variation in dorsal and anal counts than does *C. macdonaldi*, *C. marleyi* has $8\frac{1}{2}$ anal rays while *C. macdonaldi* can have from $8\frac{1}{2}$ to $10\frac{1}{2}$ (usually $9\frac{1}{2}$). Most specimens of *C. marleyi* have soft dorsal counts of $9\frac{1}{2}$, but one specimen from Mozambique had $10\frac{1}{2}$ (Smith, 1963). The preopercular spines are very similar in both species; *C. macdonaldi* has 3 to 5 teeth along the inner margin depending upon the size of the fish and counts can vary on two sides (fig. 18) while *C. marleyi* can have 3 to 6 teeth and only 6 in large adults (the recurved tip has been counted along with the teeth on the inner margin in Smith's description) and the counts can vary on both sides. I have not counted the recurved tip in my description, but if I did *C. macdonaldi* would also have 6 teeth in large adults.

DISTRIBUTION: From coastal Queensland and New South Wales (McCulloch, 1929; Marshall, 1965).

***Callionymus calcaratus* Macleay**

(Figs. 19–22)

Callionymus calcaratus Macleay, 1881a, p. 628; 1881b, p. 263; Tenison-Woods, 1883, p. 19. Ogilby, 1885, p. 121. McCulloch, 1922, p. 103; 1923, p. 10, pl. 3, fig. 2; 1926, p. 204; 1927, p. 77; 1929, p. 338; 1934, p. 77. T. D. Scott, 1962, p. 168. Mees, 1963, p. 96. Schultz, 1960, p. 403. Marshall, 1965, p. 381.

Callionymus ocelligena McCulloch, 1926, p. 207; 1929, p. 339. Schultz, 1960, p. 403. Johnson, 1969, p. 208.

Callionymus curvicornis: Ogilby, 1886, p. 37. Stead, 1901, p. 476. Waite, 1904, p. 51. Stead, 1906, p. 208.

Callionymus reevesi: Ramsay and Ogilby, 1886, (1887?), p. 942. Waite, 1904, p. 51.

Repomucenus calcaratus: Whitley, 1931, p. 323; 1948a, p. 27; 1948b, p. 275.

Repomucenus sp. nov.: Whitley, 1945, p. 42.

MATERIAL EXAMINED: 561 specimens, 104–165 mm SL, from coastal Queensland (S. of Double Island Point, 22–8 fm; 6–10 miles N. of Noosa, 20 fm; 10 miles N. of Noosa, 21–2 fm; E. of Mooloolaba, 19–19.5 fm; SE. of Mooloolaba, 19–23 fm; Mooloolaba to Caloundra, 19–22.5 fm; E. of Caloundra, 18 fm; 8 miles N. of Cape Moreton, Moreton I., 40 fm; E. of Cape Moreton, 55–9 fm; off Lucinda Bay, Moreton I., 18 fm; 6 miles E. of Scarborough, 8–9 fm) New South Wales (Tweed Heads (CSIRO collection, Cronulla); Wallis Lake; Princess Royal Harbour (Aust. Mus. records); Twofold Bay (Cronulla collection)). Six specimens, Queensland Museum, I4739 (Wide Bay), I4740 (Port Jackson), I2129 (Moreton Bay), I2140 (Moreton Bay), I3427 (southern Queensland), I9263 (Gneering Shoal). Four specimens, Australian Museum IB.358, IA.7858, I7239 (2 spec.), IA.4189.

DESCRIPTION: Dorsal IV, $9\frac{1}{2}$; anal $9\frac{1}{2}$; pectoral ii16ii, i17i, i17ii, i17iii, i18i or i18ii (usually i17ii or i17iii); ventral I,5; caudal ii7ii or ii7iii; preopercular spine broad with 3 or 4 teeth besides recurved tip and basal antrorse spine; only last dorsal ray divided; first dorsal origin well behind gill openings; usually only first pectoral ray simple, sometimes first two are simple in juveniles; first dorsal short, with a large, incomplete dark ring between 3rd and 4th spine (not always present) in males and a black blotch against a white background in females; conspicuous grey ocelli with yellow margins between mouth and preopercular spine, preorbital region and operculum in males.

Head 3.44 to 3.78; head width 3.88 to 4.74; length of pectoral fin 4.04 to 4.56; body depth 8.34 to 11.19; all in standard length. Eye 3.64 to 4.12; snout 3.14 to 4.34; pectoral fin length 1.07 to 1.30; all in head length. Eye 0.92 to 1.24 in snout.

COLOUR IN ALCOHOL: Will be discussed under the remarks section.

SEXUAL DIMORPHISM: Generally males are slightly larger than females but this is not nearly as marked in such species as *C. sublaevis* or *C. calauropomus*. The second dorsal fin shows marked sexual dimorphism with the rays being longer in males (fig. 19). The first dorsal spine (fig. 20), the caudal rays (fig. 21), and the last anal ray are longer in males. The anal papilla is much longer in males than in females. Marked differences occur in the colour markings between sexes and will be discussed in the following section.

REMARKS: In my examination of the species of dragonets from Queensland it became apparent that *C. calcaratus* Macleay and *C. ocelligena* McCulloch were strikingly similar in counts, measurements and appearance except for colour markings. *C. ocelligena* was described from a single male specimen in which the collection data had been lost (McCulloch

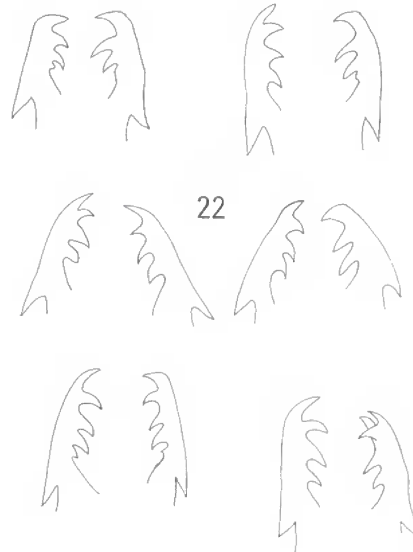
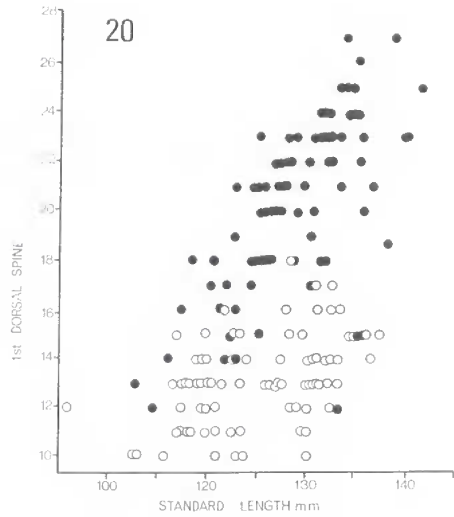
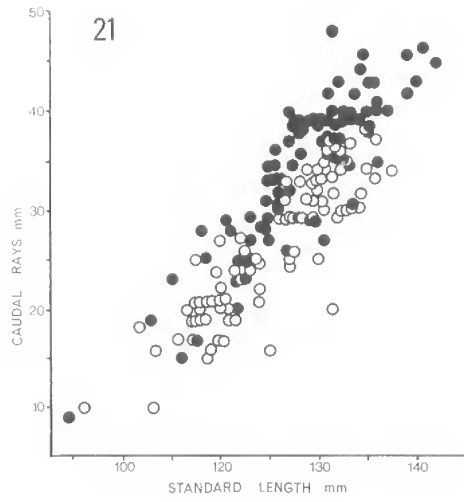
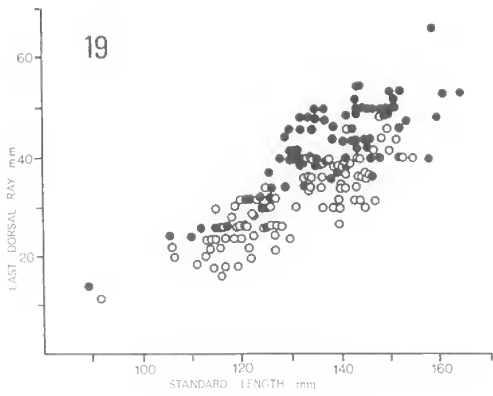


FIG. 19: Sexual dimorphism of the last dorsal ray in *C. calcaratus*. Dark circles males (n=90), open circles females (n=95).

FIG. 20: Sexual dimorphism of the first dorsal spine in *C. calcaratus*. Dark circles males (n=90), open circles females (n=95).

FIG. 21: Sexual dimorphism of the caudal rays in *C. calcaratus*. Dark circles males (n=90), open circles females (n=95).

FIG. 22: Examples of variation in right and left preopercular spines of *C. calcaratus*.

1926). The type specimen was deposited in the Australian Museum (McCulloch, 1929) but has since disappeared. McCulloch (1926) stated that *C. calcaratus* had the closest affinity to *C. ocelligena* and that *C. ocelligena* was readily distinguishable from *C. calcaratus* by its colour markings (large brown ocelli between mouth and preopercular spine, preorbital region and operculum; large black, white-edged spot on the operculum beneath the preopercular spine), longer caudal fin and having the first dorsal spine longer than the second. All these features are ones that can be affected by sexual dimorphism in this group.

So far over 500 specimens of *C. calcaratus* and *C. ocelligena* have been collected and examined along the Queensland coast. In all cases these two species were found to co-occur and all the *C. calcaratus* collected have been females while all the *C. ocelligena* collected have been males. The brain pattern is identical in both whereas great variability occurs at the interspecific level within the genus *Callionymus* thus examined (Johnson, 1971). Gonadal development and other aspects of their biology coincide. Material from the Queensland Museum showed all *C. calcaratus* to be females and *C. ocelligena* (only one specimen) to be male. Fin ray counts for 16 females (*C. calcaratus*) were D IV, $9\frac{1}{2}$; anal $9\frac{1}{2}$; pectoral ii16ii, i17i, i17ii, i17iii, i18i or i18ii; ventral I,5; caudal ii7ii or ii7iii. Counts for 17 males (*C. ocelligena*) were identical except for less variation in pectoral counts (i17ii, i17iii or i18ii).

From all the material at hand it appears that *C. ocelligena* and *C. calcaratus* are synonymous and that *C. ocelligena* is the male and *C. calcaratus* is the female of the same species, the name of which should be *C. calcaratus*.

The colour of the female *C. calcaratus* fits that described by McCulloch (1923). The colour of the male *C. calcaratus* (*C. ocelligena*) preserved in alcohol from Queensland is as follows: Background colouration yellowish brown, dorsal surface covered with indistinct small grey and orange spots with dark margins; ventral surface white; conspicuous grey ocelli with yellow margins between mouth and preopercular spine, preorbital region and operculum; along the sides of the body are dark blotches below the lateral line (not present in some specimens); bluish grey to black, white-edged spot on operculum beneath preopercular spine; first dorsal with a large, incomplete dark ring between 3rd and 4th spine (not present in some specimens), but instead fin mottled with dark brown and yellow spots similar to those on back; second dorsal mottled with dark brown and yellow spots with yellow margins; anal fin bluish grey to grey; caudal fin with irregular yellow and dark brown dots with yellow margins, with or without a grey stripe on lower rays.

The preopercular spine is highly variable in this species (fig. 22). The counts may vary on two sides and the number of spines appears to be a function of growth. A 20 mm specimen, doubtfully referred to this species, had 3 teeth with the third just forming, and one 33 mm specimen had only 2 teeth along the inner margin. This 33 mm specimen also had some interesting variation in fin counts with the dorsal IV, $8\frac{1}{2}$, and anal $7\frac{1}{2}$. Not much variation is encountered in the counts on adults.

DISTRIBUTION: Known from coastal Queensland (mouth of Wide Bay (McCulloch, 1926); Port Douglas, near mouth of Mary River; South Head, Mary River; Tangalooma Point, Moreton Bay; off Point Lookout, Stradbroke I. (Australian Museum records, from Mees, 1963)), New South Wales (northern New South Wales (McCulloch, 1926); apparently not uncommon at Port Jackson (type locality) (Stead, 1906)), South Australia (Port Lincoln and off York Peninsula (Mees, 1963)), and Western Australia (Cape Jaubert; Wallal, 5 miles offshore, 5 fm; Hampton Harbour; Dampier Archipelago; Exmouth Gulf; Houtman's Abrolhos; Fremantle; Useless Inlet and off Kok's I., Shark Bay (Mees, 1963; Whitley, 1948a; McCulloch, 1926)).

Callionymus limiceps Ogilby

Callionymus limiceps Ogilby, 1908, p. 35. McCulloch, 1923, p. 9; 1926, p. 203; 1929, p. 340. McCulloch and Whitley, 1925, p. 173. Whitley, 1929, p. 115, figs. 3, 4. Schultz, 1960, p. 403. Mees, 1963, p. 98 (*C. limiceps* mentioned; but only *C. l. sublaevis* (*C. sublaevis*) known in Western Australia). Marshall, 1965, p. 380-1.

Callionymus limiceps var. *typica* McCulloch, 1926, pp. 195, 203.

Veslesionymus limiceps: Whitley, 1934, suppl. no. 418a.

MATERIAL EXAMINED: 162 specimens, 86-159 mm SL, coastal Queensland (10 miles N. of Noosa, 21-2 fm; E. of Mooloolaba, 19-22.5 fm; between Caloundra and Mooloolaba, 19-19.5 fm; E. of Caloundra, 18 fm), Moreton Bay (3 miles SW. of Tangalooma, Moreton I., 14.5-18 fm; off Shark Spit, Moreton I., 15 fm; W. of Sand Hills, Moreton I., 10-13 fm; W. of Lucinda Bay, Moreton I., 16-18 fm; 1 mile N. of Cowan Cowan, Moreton I., 2 fm; off Mud I., 5 fm; 1 mile E. of SE. corner of St Helena I., 5 fm). Fifteen specimens, Queensland Museum (I4038; I487, 3 spec.; I9492-9; I3340-1; I3360).

DESCRIPTION: Dorsal IV, $9\frac{1}{2}$; anal $9\frac{1}{2}$; pectoral i16i, i16ii, i16iii, i17i or i17ii; ventral I,5; caudal i7ii or ii7ii; preopercular spine with a recurved tip and one antrorse tooth on inner margin and an antrorse spine near the base; only first pectoral ray simple; males with elongated first dorsal rays and a small black spot covering almost the entire fin; occiput and supraorbital ridges rugose.

Head length 3.87 to 4.19; pectoral fin length 4.71 to 5.60; head width 3.77 to 4.08; body depth 10.44 to 11.30; all in standard length. Eye 3.80 to 4.22; snout 2.24 to 2.82; pectoral fin length 1.19 to 1.41; all in length of head. Eye 1.41 to 1.70 in snout.

COLOUR IN ALCOHOL: Consistent with the descriptions by Ogilby (1908) and McCulloch (1923).

SEXUAL DIMORPHISM: Great sexual dimorphism occurs in the length of the first dorsal spines and anal papilla. Minor size differences between sexes are also apparent. Minor colour differences occur as in the markings on the first dorsal fins and anal rays.

DISTRIBUTION: Coastal Queensland, previously from between Hervey Bay and Port Denison, 13–26 fm (McCulloch, 1923).

***Callionymus sublaevis* McCulloch**

(Figs. 23–6)

Callionymus limiceps var. *sublaevis* McCulloch, 1926, p. 204; 1929, p. 340. Mees, 1963, p. 98. Johnson, 1970, p. 294.

MATERIAL EXAMINED: 1322 specimens, 51–134 mm SL, coastal Queensland (6 miles E. of Mackay, 13 fm; E. of Caloundra, 15 fm) and Moreton Bay (1.5–2 miles E. of Bishop I., 2.5–3 fm; W. of Green Island, 2–6 fm; between St Helena I. and Green I., 4–4.5 fm; $\frac{1}{2}$ to 1 mile E. of St Helena I., 5–6 fm; 2.5 miles E. of Mud I., 5–10 fm; $\frac{1}{4}$ mile E. of Mud I., 5–7.5 fm; 2 miles E. of Redcliffe, 2 fm; 6 miles E. of Scarborough, 8–9 fm; W. of Sand Hills, Moreton I., 7–17 fm; 3 miles SW. of Tangalooma, Moreton I., 14.5–18 fm; 4 miles N. of Shark Spit, Moreton I., 14–17 fm; 5 miles SW. of Shark Spit, 11–16 fm; W. of Shark Spit, 11–16 fm; W. of Lucinda Bay, Moreton I., 7–18 fm). Six specimens, Australian Museum, 115557–218, Gulf of Carpentaria, 16°37'S, 140°43'E.

DESCRIPTION: Dorsal IV, $9\frac{1}{2}$; anal $9\frac{1}{2}$; pectoral i16ii, i16iii or i17i (usually i17i); ventral I,5; caudal ii6ii, ii7ii or ii7iii (usually ii7iii); similar to *C. limiceps* in most aspects except in minor colour differences, smaller size and having the occiput and supraorbital ridges almost entirely smooth and covered by skin; preopercular spine with 1 to 2 teeth along inner margin besides recurved tip, basal antrorse spine present.

Head 3.60 to 3.92; head width 3.48 to 4.40; length of pectoral fin 4.62 to 4.81; body depth 9.80 to 11.36; all in standard length. Eye 3.66 to 4.14; snout 2.89 to 3.11; pectoral fin 1.19 to 1.32; all in head length. Eye 1.20 to 1.43 in snout.

COLOUR IN ALCOHOL: Brown above, mottled with white spots; first dorsal in male dusky and lacks the black spot between 2nd and 4th spine as in *C. limiceps*; first dorsal in female black; filamentous spines with grey annuli; second dorsal with grey and white streaks; caudal with many white spots between rays; anal fin in male with broad dusky to black margin, narrow in female; ventrals black in male, dusky in females; pectorals pale; 5–6 brown spots along side of body with brown lines vertically in interspaces. In males 74 mm and smaller, the ventral fins and anal fins are similar to female. In a 92 mm male, the ventral fins are partially black and edged with white.

SEXUAL DIMORPHISM: Differences occur in body size with females usually being smaller. The first dorsal spines are greatly elongated in males (fig. 23). Fig. 24 shows the differences in length of the caudal fin rays between sexes. Anal papilla length is greater in males (fig. 25). Colour differences are discussed above.

REMARKS: McCulloch (1926) regarded *C. l. sublaevis* as an exceptional variation of *C. limiceps*. Mees (1963) did not believe *C. limiceps* and *C. l. sublaevis* to be different species or subspecies as they were reported to co-occur along the Queensland coast. I believe them to be distinct at the specific level. Although they do co-occur, it is the exception rather than

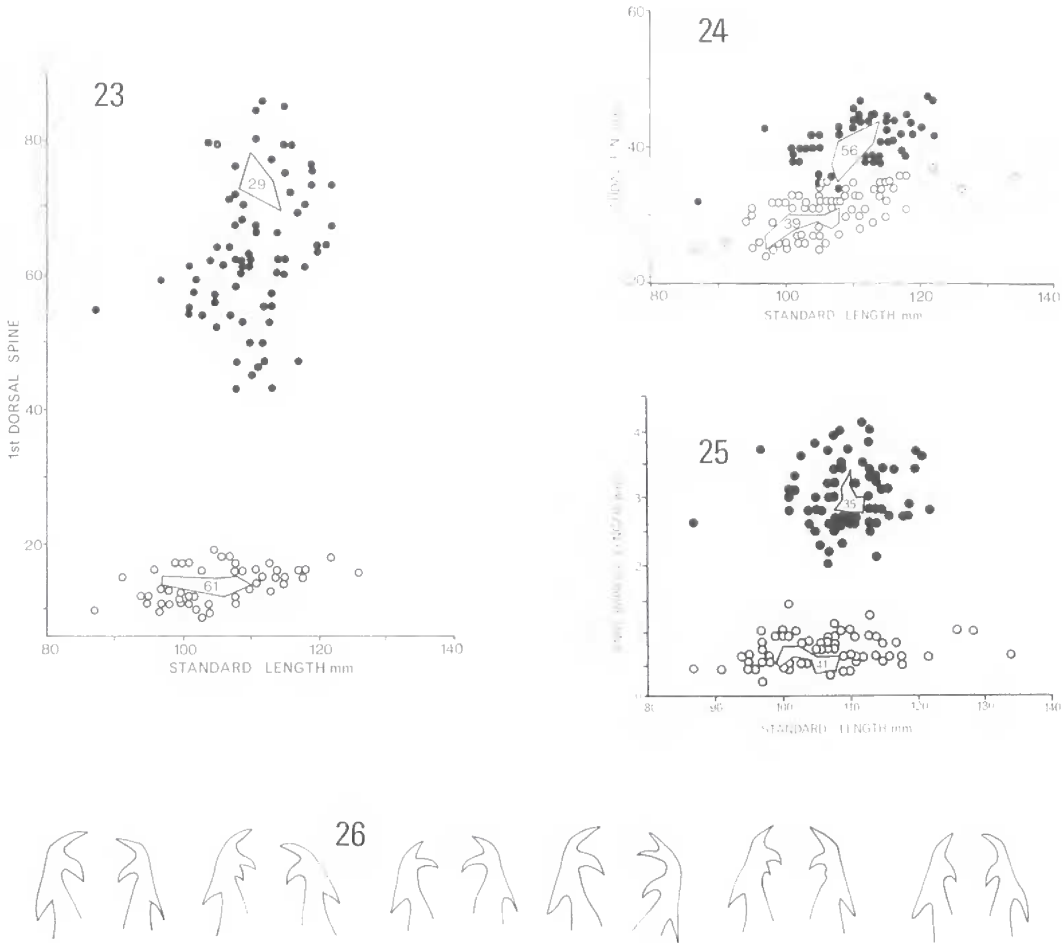


FIG. 23: Sexual dimorphism of the first dorsal spine in *C. sublaevis*. Dark circles males (n=100), open circles females (n=100).

FIG. 24: Sexual dimorphism of the caudal fin in *C. sublaevis*. Dark circles males (n=100), open circles females (n=100).

FIG. 25: Sexual dimorphism of the anal papilla in *C. sublaevis*. Dark circles males (n=100), open circles females (n=100).

FIG. 26: Examples of variation in right and left preopercular spines of *C. sublaevis*

the rule. I have found *C. limiceps* usually outside Moreton Bay at depths from 18 to 22 fm while *C. sublaevis* is most common inside Moreton Bay at depths from 2 to 18 fm. Usually distinct populations exist in either *C. sublaevis* or *C. limiceps*. No more than two *C. limiceps* have ever been encountered in any trawl with *C. sublaevis* in Moreton Bay and no *C. sublaevis* has ever been taken by me with *C. limiceps* in the hundred of trawls made outside the bay. Both are biologically distinct and juveniles can be found in both. The brain patterns are distinctly different in *C. limiceps* and *C. sublaevis* (Johnson, 1971).

Much variation exists in the shape of preopercular spines and counts can vary on two sides (fig. 26).

DISTRIBUTION: 13 miles SE. of Cape Capricorn, 13 fm; 7–10 miles NW. of Hummocky I., near Cape Capricorn, 14–16 fm (holotype) (McCulloch, 1926). Coastal Queensland from off Townsville, 11 fm, south to Moreton Bay (Johnson, 1970). In Western Australia from Dampier Archipelago, Exmouth Gulf and Shark Bay (Mees, 1963).

***Callionymus goodladi* Whitley**

Calliurichthys goodladi Whitley, 1944, p. 270; 1948a, p. 27.

Callionymus goodladi: Mees, 1963, p. 97.

MATERIAL EXAMINED: 7 specimens, 110–160 mm SL, Western Australian Museum (P4369, 4 specimens; P5037; P4540; P5442).

DESCRIPTION: Dorsal IV, $8\frac{1}{2}$; anal $7\frac{1}{2}$; pectoral ii15ii, ii15iii or ii16i; ventral I,5; caudal ii7ii or ii7iii; preopercular spine straight with 8 to 12 small serrations along inner margin and a large antrorse spine at base; snout large and prominent; origin of first dorsal nearly on line with gill openings; first and second pectoral rays simple.

Head length 3.07 to 3.54; head width 3.84 to 4.12; length of pectoral fin 4.55 to 5.12; body depth 8.78 to 10.00; all in standard length. Eye 4.42 to 5.71; snout 2.16 to 2.57; pectoral fin length 1.29 to 1.56; all in head length. Eye 1.77 to 2.42 in snout.

COLOUR IN ALCOHOL: As described by Whitley (1944) except that in some specimens the head is brownish grey above and the chin and brachioistegals are white or brown with a bluish tinge.

SEXUAL DIMORPHISM: Pronounced sexual dimorphism is not apparent in this species although some differences in fin length may exist.

DISTRIBUTION: Known only from Western Australia, from Cheyne Beach and near Michaelmas I., King George Sound, Cockburn Sound, Shark Bay (entrance to South Passage, exact locality not known) and Exmouth Gulf (Mees, 1963).

Callionymus calliste Jordan and Fowler

Callionymus calliste Jordan and Fowler, 1903, p. 957. Marshall, 1965, p. 380.

Callionymus hudsoni Fowler, 1941, p. 8.

Callionymus distethommatius Fowler, 1941, p. 18.

MATERIAL EXAMINED: Two specimens, 29 and 31 mm SL, Australian Museum, IA.4463, IA.4630 Low Isles, Queensland.

DESCRIPTION: Dorsal IV, $8\frac{1}{2}$; anal $7\frac{1}{2}$; pectoral i13ii or i13iii; ventral I,5; caudal ii7ii or ii7iii; preopercular spine with 3 hooks along upper margin and a short basal antrorse spine; lateral line simple and not connected by a branch on top of caudal peduncle; gill openings approximately midway between origin of first dorsal fin and posterior edge of eyes.

Head length 3.44 to 3.62; length of pectoral 3.20 to 3.62; head width 3.64 to 4.14; depth of body 6.34 to 7.25; all in standard length. Eye 2.67 to 2.90; pectoral length 0.93 to 1.00; snout 3.81 to 4.10; all in length of head. Eye 0.70 to 0.71 in snout.

COLOUR IN ALCOHOL: Follows the description of Schultz *et al.* (1960).

DISTRIBUTION: Within Australia, known only from Low Isles, Queensland.

Callionymus rameus McCulloch

Callionymus, *Calliurichthys rameus* [sic] McCulloch, 1926, p. 201.

Callionymus rameus: McCulloch, 1929, p. 339. Schultz, 1960, p. 403. Mees, 1963, p. 99, Marshall, 1965, p. 381.

Orbonymus rameus: Whitley, 1947, p. 150.

Callionymus (*Calliurichthys*) *rameus*: Mees, 1959, p. 9; Palmer, 1962, p. 548.

MATERIAL EXAMINED: 30 specimens, 84–135 mm SL, southern Queensland (20 miles SE. of Double Island Point, 32–3 fm; 10 miles N. of Noosa, 21–2 fm; 6–10 miles N. of Noosa, 20 fm; off Caloundra, 19–19.5 fm; E. of Noosa, 41–46.5 fm. Two specimens, Queensland Museum, I4012 (paratype, SE. of Cape Capricorn, I3339 (S. coast of Queensland). One specimen, Australian Museum, I15557-286 (Gulf of Carpentaria 16°30'S, 140°43'E).

DESCRIPTION: Dorsal IV, $8\frac{1}{2}$; anal $7\frac{1}{2}$; pectoral i15ii, i16ii, i16iii, i17ii, or i17iii; ventral I,5; caudal i7ii or ii7ii; all dorsal rays divided, first ray sometimes simple; preopercular spine with 6 to 11 serrations along inner margin, antrorse spine on base; snout slightly shorter than eye; origin of first dorsal on a line with gill openings.

Head length 4.04 to 5.10; length of pectoral fin 3.38 to 4.21; head width 4.09 to 4.62; depth of body 5.79 to 7.00; all in standard length. Eye 2.24 to 3.34; pectoral length 0.84 to 1.00; snout 3.06 to 4.28; all in head length. Eye 0.59 to 0.94 in snout.

COLOUR IN ALCOHOL: Slight variations were noted from the description by McCulloch (1926); the 5 to 6 crossbands on the dorsal surface are quite distinct in some specimens, the irregular bars and spots on ventral rays are absent or very faint, and the darker part of the anal fin has a number of darker spots and bars in most specimens.

LIFE COLOURATION: The life colouration of this species is described for the first time, based upon fresh specimens from the Mackay area.

In males the background colouration is light grey dorsally, white ventrally with red blotches and streaks along sides; yellow reticulated pattern edged in red on chin and branchiostegals; head with red blotch between eye and maxillary, 2 faint red bars on operculum, 2 red blotches on lower jaw, upper jaw pink; dorsal surface with 5 to 6 dark brown to grey bars edged with red and mottled with small blue spots; membranes of first dorsal fin dark yellow or grey with vertical yellow bars with white spots and streaks edged with black, spots basal, streaks distal; second dorsal light grey with horizontal yellow and white streaks on posterior half, a few white spots along basal edge of fin and brown to grey blotches dispersed throughout fin. Caudal fin with 2 wide, vertical, dark grey bars, distinct dorsally, faint ventrally, merging into a black blotch on basal 3 rays, several blue streaks on black blotch, caudal membrane with yellow between horizontal white streaks, rays pink becoming more distinct anteriorly; anal fin black distally, yellowish grey basally with blue horizontal broken streaks edged with black; pectoral fin with membrane clear, rays with minute white and red spots; ventral fin light grey with 2 darker grey wide patches distally and basally across rays, irregular white spots or yellow background basally, red blotches on rays.

In females the background is lighter, ventral surface with a wide indistinct pink patch beginning at 2nd anal ray extending to 6th anal ray; head as in males, reticulated pattern on chin and branchiostegals red instead of yellow; first dorsal fin darker with less yellow, bars with white spots, no streaks; second dorsal with white streaks posteriorly, no yellow streaks; caudal fin whitish yellow, vertical black bars more distinct and fuse into basal black blotch with several blue spots, white horizontal broken streaks present, fin pinker basally; anal fin with blue spots instead of streaks; pectoral and ventral fins as in males.

SEXUAL DIMORPHISM: Besides the colour differences discussed above, the first dorsal fin, caudal fin and anal papilla are longer in males.

DISTRIBUTION: Previously from Queensland (Gulf of Carpentaria (Australian Museum record); 6 miles E. of Mackay, 13 fm; SE. of Cape Capricorn, 13 fm (type locality); 25 miles SE. of Double Island Point, 33 fm; 4–20 miles NE. of Gloucester Head, 19–35 fm (McCulloch, 1926)), Western Australia (Shark Bay (exact location not known); 40 miles S. of Carnarvon (Mees, 1963), and off the Monte Bello Islands (Palmer, 1962)).

Callionymus papilio Günther

Callionymus papilio Günther, 1864, p. 197. Lucas, 1890, p. 29. Waite, 1904, p. 51. McCulloch, 1922, p. 103; 1923, p. 13; 1927, p. 77; 1929, p. 338; 1934, p. 77. Lord, 1923, p. 69; 1927, p. 87. Lord and H. H. Scott, 1924, pp. 12, 78. E. O. G. Scott, 1953, p. 157. T. D. Scott, 1962, p. 168. Mees, 1963, p. 98.

Callionymus ocellifer Castelnau, 1873, p. 49.

Callionymus lateralis Macleay, 1881a, p. 628; 1881b, p. 263. Johnston, 1891, p. 33.

Callionymus macleayi Ogilby, 1886, p. 37—*nomen novum* for *Callionymus lateralis* Macleay, *nec Callionymus lateralis* Richardson.

Callionymus Papilio: Macleay, 1881a, p. 627; 1881b, p. 262.

Callionymus latealis: Tenison-Woods, 1883, p. 19.

Foetorepus papilio: Whitley, 1931, p. 323; 1945, p. 42; 1948a, p. 27.

MATERIAL EXAMINED: 2 specimens, South Australian Museum, F3129, Cape Elizabeth, York Peninsula, South Australia. Four specimens, Australian Museum, I15731-007, B9753, I5004, Point Peron, 30 miles S. of Perth, 32°16'S, 115°40'E.

DESCRIPTION: Dorsal IV, $7\frac{1}{2}$; anal $6\frac{1}{2}$; pectoral i12iiii, i13ii, i15iii or i15iiii; ventral I,5; caudal i7ii, i7iii or ii7ii; all dorsal rays divided at tips except first; preopercular spine resembles that described for *C. calauropomus* with one single curved hook besides tip which is curved upward and no basal antrorse spine present; a small species.

Head length 3.41 to 4.00; length of pectoral fin 4.10 to 4.66; head width 3.66 to 4.31; body depth 5.70 to 7.00; all in standard length. Eye 3.00 to 3.86; pectoral length 1.20 to 1.31; snout 3.08 to 4.24. Eye 0.91 to 1.08 in snout.

COLOUR IN ALCOHOL: Background colouration light brown to dark grey with lighter blotches dorsally, these blotches arranged symmetrically and similar in males and females; ventral surface silvery anteriorly becoming brownish posteriorly with silvery white spots on branchiostegals and chin; head same as body with a distinct white patch below eye in both sexes; males with thin white vertical lines and a few faint white spots on sides of body

below lateral line, thin vertical lines absent in females and replaced by numerous white spots below lateral line; first dorsal with black spot on distal portion of membrane between 1st and 2nd spine (also present in juveniles), spines black at tips in adults, 3 irregular horizontal bands of thin white stripes, markings not as distinct in females. Second dorsal in males with 3 horizontal bands of thin white stripes, edged in black on a brown background, in females, membranes clear and mottled with faint white and brown blotches (juveniles lack the black edges of horizontal white bands); pectoral fin clear in both sexes; anal fin in males brown with distal black stripe, clear in females; caudal fin with upper rays clear and lower rays with white and brown spots on membranes, caudal rays in females entirely mottled with white and brown and membranes clear; ventral fin mottled with brown and white blotches, clear in juveniles.

SEXUAL DIMORPHISM: Besides the colour differences noted above, the only difference apparent is that males have slightly longer dorsal spines.

REMARKS: According to McCulloch (1923) this species can have $8\frac{1}{2}$ dorsal rays, but all the material I examined had $7\frac{1}{2}$.

DISTRIBUTION: Known from Port Jackson, New South Wales, southward to Victoria (McCulloch, 1923); from Tasmania (Lord, 1923; McCulloch, 1923, 1929; E. O. G. Scott, 1953; T. D. Scott, 1962).

ACKNOWLEDGMENTS

Many persons played an important role in making this study possible. From the University of Queensland, I wish to thank L. Wale (Captain of the R/V *Wanderer* II), A. Lewis, B. Smith, M. Johnston, R. Bradbury and A. Jones for assistance in obtaining specimens. N. Smales (L. F. B. *Bossanova*) and I. McDonald (L. F. B. *Jodi*) supplied much of the off-shore material and K. Boxwell (L. F. B. *Seabelle*) and A. Johnson also helped in this respect.

A. Hinton, L. W. Filewood and P. Kailola, Research and Survey Station, kindly loaned me New Guinean material.

Museum material was secured through the efforts of Drs V. G. Springer, U.S. National Museum, W. Freihofer, Stanford University, L. P. Woods and K. Liem, Field Museum of Natural History, J. R. Paxton, Australian Museum, R. J. McKay, Western Australian Museum, W. M. Eschmeyer, California Academy of Sciences, A. Ochiai, Kochi University, T. Iwai, Kyoto University, C. J. M. Glover, South Australian Museum, and Alwyne Wheeler, British Museum.

I wish to thank my wife, Colleen for preparing the figures and for her patience and encouragement throughout the study.

Professor J. M. Thomson and Dr P. Dwyer, University of Queensland kindly offered advice concerning the manuscript. The research was supported by AUC and URG research grants to the University of Queensland.

LITERATURE CITED

- BLEEKER, P., 1854. Faunae ichthyologicae japonicae species novae. *Natuurk. Tijdschr. Ned.-Ind.* **6**: 395–426.
1879. Revision des especes insulidiennes de la famille des Callionymoides. *Versl. Akad. Amsterdam.* **14**: 79–107.
- CASTELNAU, F. L., 1873. Contribution to the Ichthyology of Australia, No. 3. Supplement to the fishes of Victoria. *Proc. Zool. and Acclimatization Soc. Vic.* **2**: 37–58.
1875. Researches on the Fishes of Australia. In 'Philadelphia Centennial Exhibition of 1876'. (Melbourne, 1875): Official Record, Intercolonial Exhibition Essays No. 2, pp. 1–52.
- DE BEAUFORT, F. F. and CHAPMAN, W. M., 1951. 'The fishes of the Indo-Australian Archipelago.' Vol. 9. (E. J. Brill: Leiden).
- DE VIS, C. W., 1883. Description of two new Queensland fishes. *Proc. Linn. Soc. N.S.W.* (1) **7**: 620–1.
- FOWLER, H. W., 1941. New Fishes of the family Callionymidae, mostly Philippine, obtained by the United States Bureau of Fisheries Steamer "Albatross". *Proc. U.S. Nat. Mus.* **90**: 1–31.
1959. 'Fishes of Fiji'. (Govt. Fiji: Suva).
- GLAUERT, L., 1921. Fish collected by the government trawler "Penguin" near Albany. *J. roy. Soc. W. Aust.* **7**: 44–7.
- GÜNTHER, A., 1861. 'Catalogue of the Acanthopterygian fishes in the collection of the British Museum'. Vol. 3 (British Museum: London).
1864. Description of a new species of *Callionymus* from Australia. *Ann. Mag. Nat. Hist.* (3) **14**: 197–8.
1880. Report on the shore fishes procured during the voyage of H.M.S. "Challenger" in the years 1873–1876. In 'Report on the Scientific Results of the Voyage of H.M.S. "Challenger" during the years 1873 to 1876'. Zoology, 1 (6): 1–82, pls. 1–32.
- HOUTTUYN, M., 1782. Beskrivning van Eenige Japanske Visschen. *Verh. Holl. Matt. Wet. Haarlem.* **20** (2): 311.
- JOHNSON, C. R., 1969. First report of *Callionymus ocelligena* from Queensland Waters. *Aust. J. Sci.* **32**: 208.
1970. Northern distribution records for some eastern Australian dragonets (Pisces : Callionymidae). *Aust. J. Sci.* **32** (7): 294.
1971. Systematics and biology of Australian *Callionymus* (Pisces : Callionymidae). Ph.D. Thesis, University of Queensland.
- JOHNSTON, R. M., 1891. Further observations upon the fishes and fishing industries of Tasmania, together with a revised list of indigenous species. *Pap. Proc. Roy. Soc. Tas.* **1890**: 22–46.
- JORDAN, D. S. and FOWLER, H. W., 1903. A review of the dragonets (Callionymidae) and related fishes of the waters of Japan. *Proc. U.S. Nat. Mus.* **25** (1305): 939–59.

- JORDAN, D. S. and HUBBS, C. L., 1925. Record of fishes obtained by David Starr Jordan in Japan, 1922. *Mem. Carnegie Mus.* **10** (2): 93–346.
- LORD, C., 1923. A list of the fishes of Tasmania. *Pap. Proc. Roy. Soc. Tas.* **1922**: 60–73.
1927. The Vertebrate Fauna of Tasmania. In GIBLIN, 'Handbook of Tasmania'. pp. 82–9.
- LORD, C. E. and SCOTT, H. H., 1924. 'A synopsis of the vertebrate animals of Australia'. pp. 1–96, illustrated.
- LUCAS, A. H. S., 1890. A systematic census of indigenous fish, hitherto recorded from Victorian waters. *Proc. Roy. Soc. Vic.* (new series) **2**: 15–47.
- MACLEAY, W., 1881a. Descriptive catalogue of the fishes of Australia, Parts I and II. *Proc. Linn. Soc. N.S.W.* (1) **5** (3): 302–444; (1) **5** (4): 510–629, pls. 13–14.
1881b. 'Descriptive catalogue of Australian Fishes'. Vol. 1. pp. 1–264. (F. W. White: Sydney).
1884. Supplement to the descriptive catalogue of the fishes of Australia. *Proc. Linn. Soc. N.S.W.* (1) **9**: 2–64.
- MARSHALL, T. C., 1951. 'Ichthyological notes No. 1'. pp. 1–9, pls. 1–3. (Dept. Harbours and Marine: Brisbane).
1965. 'Fishes of the Great Barrier Reef and coastal waters of Queensland'. pp. 1–566, pls. 1–64, 1–72. (Halstead Press: Sydney).
- MCCOY, F., 1878–90. 'Prodromus of the Zoology of Victoria'. 20 decades in 2 vols. pp. 1–375, pls. 1–200. (Govt. Printer: Melbourne).
- MCCULLOCH, A. R., 1922. Check list of the fish and fish-like animals of New South Wales. *Aust. Zool.* **2** (3): 86–130.
1923. Notes on fishes from Australia and Lord Howe Island. *Rec. Aust. Mus.* **14**: 1–17.
1926. Report on some fishes obtained by the F.I.S. "Endeavour" on the coasts of Queensland, New South Wales, Victoria, Tasmania, South and south-western Australia. In 'Biological Results of the Fishing Experiments carried on by F.I.S. "Endeavour".' Vol. 5: 157–216, pls. 43–56.
1927. 'The fishes and fish-like animals of New South Wales with supplement by G. P. Whitley.' 2nd ed. (Royal Zoological Society, New South Wales: Sydney).
1929. A check-list of the fishes recorded from Australia. *Mem. Aust. Mus.* **5**: 1–534.
1934. 'The fishes and fish-like animals of New South Wales with supplement by G. P. Whitley'. 3rd ed. (Royal Zoological Society New South Wales: Sydney).
- MCCULLOCH, A. R. and WAITE, G. R., 1918. Some new and little-known fishes from South Australia. *Rec. S. Aust. Mus.* **1**: 39–78.
- MCCULLOCH, A. R. and WHITLEY, G. P., 1925. A list of the fishes recorded from Queensland waters. *Mem. Qd Mus.* **8**: 125–82.
- MEES, G. F., 1959. Additions to the fish fauna of Western Australia, 1. *W. A. Fisheries Bull.* **9**: 1–12.
1963. The Callionymidae of Western Australia (Pisces). *J. Roy. Soc. W. Aust.* **46** (3): 93–9.
- MUNRO, I. S. R., 1967. 'The fishes of New Guinea'. pp. i–xxxvii, 1–651, pls. 1–78. (Department Agriculture Stock and Fisheries: Port Moresby).
- NORMAN, J. R., 1937. Fishes. B.A.N.Z. Antarctic Research Expedition Report Series B. Vol. 1, No. 2, pp. 49–88.
- OCHIAI, A., ARAGA, C. and NAKAJIMA, M., 1955. A revision of the dragonets referable to the genus *Callionymus* found in the waters of Japan. *Publ. Seto. Mar. Biol. Lab.* **5** (1): 95–132.

- OGILBY, J. D., 1886. Catalogue of the Fishes of N.S.W. with their principal synonyms. Reports to Commissioner of Fisheries N.S.W. Appendix A, pp. 1-67.
1908. New or little known fishes in the Queensland Museum. *Ann. Qd Mus.* **9**: 3-41.
- 1910a. On new or insufficiently described fishes. *Proc. Roy. Soc. Qd* **23**: 1-55.
- 1910b. On some new fishes from the Queensland coast. *Proc. Roy. Soc. Qd* **23**: 85-139. (Paper read before the Royal Society of Qd on November 20, 1910 but was withheld from publication outside of authors copies).
1911. Descriptions of new or insufficiently described fishes from Queensland waters. *Ann. Qd Mus.* **10**: 36-58.
- PALMER, G., 1962. New records of fishes from the Monte Bello Islands, Western Australia. *Ann. Mag. Nat. Hist.* (13) **4**: 545-51.
- RAMSAY, F. P. and OGILBY, J. D., 1887. On an undescribed *Sciaena*, from the New South Wales coast. *Proc. Linn. Soc. N.S.W.* **1**: 941-2.
- RICHARDSON, J., 1844. In HINDS, R. B., 'Zoology of the voyage of the H.M.S. Sulphur under Sir Edward Belcher during the years 1836-42, Vol. 1 (London).
- 1844-48. Fishes. In J. RICHARDSON and J. E. GREY (Eds.), 'The Zoology of the voyage of H.M.S. "Erebus" and "Terror", under the command of Captain Sir James Clarke Ross, R.N., F.R.S., during the years 1839 to 1843'. Vol. 2, pp. i-viii + 1-59, pls. 1-60. (E. W. Janson: London).
1846. Report on the ichthyology of the seas of China and Japan. *Rep. Brit. Ass.* **18**: 187-320.
- SCHLEGEL, H., 1845. Pisces In P. F. VON SIEBOLD 'Fauna Japonica' (J. Müller and Sons: Amsterdam).
- SCHULTZ, L. P., CHAPMAN, W. M., LACHNER, E. A. and WOODS, C. P., 1960. Fishes of the Marshall and Marianas Islands. *U.S. Nat. Mus. Bull.* **202** (2): 1-438.
- SCOTT, E. O. G., 1953. Observations on some Tasmanian fishes, part 6. *Pap. Proc. Roy. Soc. Tas.* **87**: 141-64.
- SCOTT, T. D., 1962. 'The marine and freshwater fishes of South Australia.' (Govt. Printer: Adelaide).
- SMITH, J. L. B., 1963. Fishes of the families Draconettidae and Callionymidae from the Red Sea and the Western Indian Ocean. *Rhodes University Ichthy. Bull.* **28**: 547-64.
- STEAD, D. G., 1901. In Notes and Exhibits. *Proc. Linn. Soc. N.S.W.* **25**: 476.
1906. 'Fishes of Australia: a popular and systematic guide to the study of the wealth within our waters.' (William Brooke and Co.: Sydney).
- TANAKA, S., 1917. Eleven new species of fishes from Japan. *Zool. Mag.* **29** (339): 7-12 (in Japanese).
- TEMMINK, J. C. and SCHLEGEL, H., 1843-50. Pisces. In P. F. VON SIEBOLD, 'Fauna Japonica', pp. 1-324, pls. 1-143. (J. Müller and Sons: Amsterdam).
- TENISON-WOODS, J. E., 1883. 'Fish and fisheries of New South Wales (1882)'. (Thomas Richards: Sydney).
- WAITE, E. R., 1898. Report of the fishes. In 'Sea Fisheries Report M.M.C.S. "Thetis".' pp. 23-62, pls. 1-12, 1 map.
1904. Synopsis of the fishes of New South Wales. *Mem. N.S.W. Nat. Cl.* **2**: 1-59.
1921. Catalogue of the fishes of South Australia. *Rec. S. Aust. Mus.* **2**: 1-199.
1923. 'The fishes of South Australia. Handbooks Flora and Fauna S. Australia'. (Govt. Printer: Adelaide).
1927. Supplement to the Catalogue of Fishes of South Australia. *Rec. S. Aust. Mus.* **3**: 221-34, pl. 13.

- WHITLEY, G. P., 1929. Studies in Ichthyology No. 3. *Rec. Aust. Mus.* **17**: 101–43, pls. 30–4.
1931. New names for Australian fishes. *Aust. Zool.* **6**: 310–34.
1934. Supplement to the check-list of the fishes of New South Wales. In A. R. McCULLOCH 'The Fishes and Fish-like animals of New South Wales.' 3rd ed. (Royal Zoological Society of New South Wales: Sydney).
1944. New sharks and fishes from Western Australia. *Aust. Zool.* **10**: 252–73.
1945. New sharks and fishes from Western Australia. Part 2. *Aust. Zool.* **11**: 1–42.
1947. New sharks and fishes from Western Australia, Part 3. *Aust. Zool.* **11**: 129–50, pl. 11.
- 1948a. A list of the fishes of Western Australia. *W. Aust. Fish. Dept., Fish. Bull.* **2**: 1–35.
- 1948b. New sharks and fishes from Western Australia, Part 4. *Aust. Zool.* **11**: 259–76, pls. 24–5.
1962. 'Marine Fishes of Australia.' Vol. 2, pp. 148–287. (Jacaranda Press: Brisbane).
- WOODWARD, B. H., 1902. In M. FRAZER, 'Notes on the natural history, etc. of Western Australia'. In Western Australian Year-Book for 1900–1901. (Govt. Printer: Perth).
1903. In M. FRAZER, 'Notes on the natural history, etc. of Western Australia'. pp. i–vii, 1–250, pls. 1–36. (Govt. Printer: Perth).